

APPENDIX A

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10 UNITED STATES DISTRICT COURT
11 FOR THE CENTRAL DISTRICT OF CALIFORNIA
12 WESTERN DIVISION

13 POLARIS POWERLED
14 TECHNOLOGIES, LLC

15 Plaintiff,

16 v.

17 VIZIO, INC., HON HAI
18 PRECISION INDUSTRY CO., LTD.
19 D/B/A FOXCONN TECHNOLOGY
20 GROUP, COMPETITION TEAM
21 TECHNOLOGY USA INC., TOP
22 VICTORY ELECTRONICS
23 (TAIWAN) CO. LTD., TOP
24 VICTORY INVESTMENTS LTD.,
25 TPV TECHNOLOGY LTD., TPV
26 INTERNATIONAL (USA), INC.,
27 TREND SMART AMERICA, LTD.,
28 INNOLUX CORP., INNOLUX
USA, INC., AMTRAN
TECHNOLOGY CO., LTD.,
AMTRAN LOGISTICS, INC., and
NEWEGG, INC.,

Defendants.

Case No. 2:23-cv-03478

**DEFENDANTS'
SUPPLEMENTAL RESPONSE
TO PLAINTIFF'S RESPONSIVE
CLAIM CONSTRUCTION
BRIEF**

Judge: Honorable George Wu
Date: March 18, 2024
Time: 8:30 a.m.
Courtroom: 9D

I. POLARIS’S UNDERSTANDING OF STAGGERED IS INCORRECT

A. Term 1¹: Claims 1 and 14: “staggered PWM brightness control signals” / “staggered pulse width modulated (PWM) brightness control signals”

Polaris’s Construction	Defendants’ Construction
Plain and ordinary meaning.	Identical but phase-shifted PWM brightness control signals.

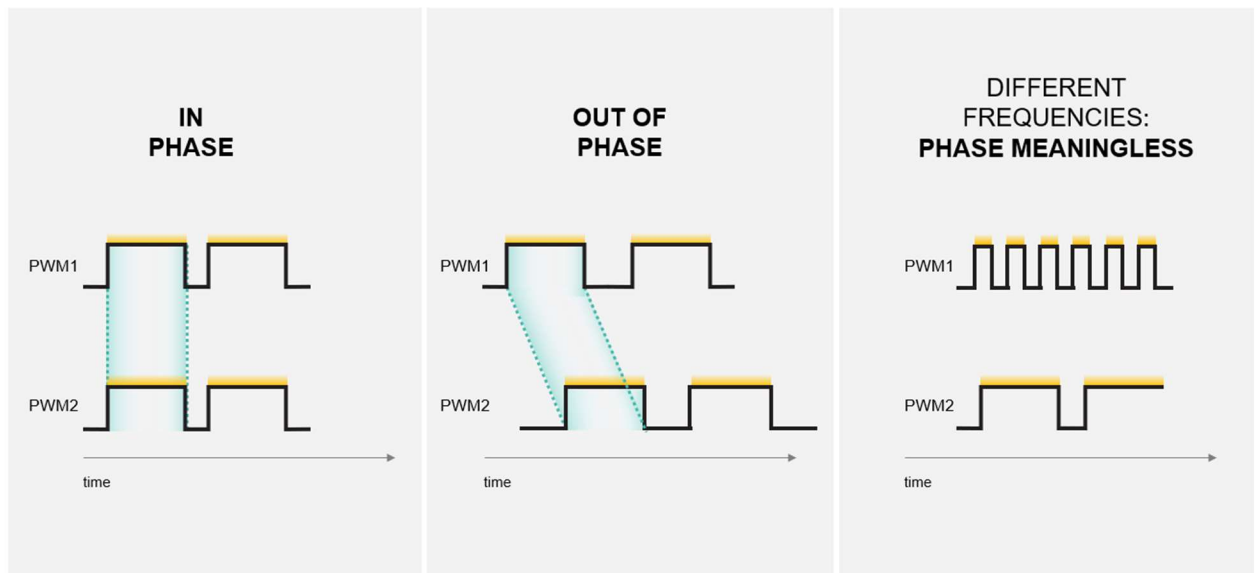
Polaris’s Responsive Claim Construction Brief raises a new argument with regard to the use of the term “staggered PWM brightness control signals” in claims 1 and 14. Polaris acknowledges that the PWM brightness control signals described and claimed in the ‘148 patent are either “in phase or out of phase,” but argues that in spite of this, “[t]here is no requirement that the individual parallel paths of LED have the same frequency.” *See* Dkt. 72 at p. 3. Thus Polaris and its expert erroneously conclude that a POSITA would understand that the “staggered” signals need not be “identical” other than being phase-shifted (as in VIZIO’s construction), because they allegedly could also vary in frequency: “the PWM brightness control signals may have different frequencies with the same duty cycle or different duty cycles with the same frequency or may have more complex waveforms.” *Id.*

Polaris and its expert are incorrect, and their new argument demonstrates a fundamental misunderstanding of the claims and the meaning of the term “phase.”

Claims 1 and 14 both require that the “staggered” PWM brightness control signals pass through “the plurality of current set circuits” and drive the LEDs at the same duty cycle “*but out of phase with each other.*” Dkt. 69-1 at 6:51-54 (emphasis added). Thus, the signals described in the claims must be “out of phase.” But two signals that are “out of phase” (or “in phase”) necessarily have the same frequency, contrary to Polaris’s position. Ex. 19 at ¶¶ 9-11.

¹ Term 1, 2, etc. refer to the number recited in the Joint Claim Construction and Prehearing Statement, ECF No. 64.

Specifically, a POSA would understand that the determination of “phase”—*i.e.*, whether two signals are “in phase” or “out of phase”—requires the signals to have the same frequency, so that a meaningful comparison can be made to determine if the corresponding values of each signal’s waveform align (are “in phase”) or do not align (are “out of phase”). Ex. 19 at ¶¶ 10-18; *see also* definitions below. For instance, two rectangular pulse signals are “in phase” when their corresponding peaks and valleys align, whereas such signals are “out of phase” when they do not align. *Id.* at ¶ 10. Said differently, the “in phase” signals will have the same values at any point in time, whereas “out of phase” signals will have the same values, but time shifted. *Id.* This is illustrated in the figure below, which shows “in phase” signals on the left, “out of phase” signals in the middle, and signals with varying frequencies on the far right:



As shown above, if the signals lack the same frequency, the concept of “phase” becomes meaningless: POSAs do not consider signals at different frequencies “in phase” or “out of phase” because there is no meaningful way to determine if the various points in those signals match up. *Id.* at ¶ 11. Such signals have no phase relationship. *Id.*

1 That signals described as having an “in phase” or “out of phase” relationship
 2 have the same frequency is consistently demonstrated in electrical engineering
 3 definitions of the term “phase” and its derivatives (*i.e.*, “in phase” or “out of phase”).
 4 As set forth in Exhibits 20 through 25, dictionaries defining the term “phase” and its
 5 derivatives consistently require the compared signals to have the same frequency:²

- 6 • Wiley Electrical and Electronics Engineering Dictionary (Ex. 20) defines
 7 the term “out-of-phase” as “a state in which two or more periodic
 8 quantities ***having the same frequency and waveshape*** do not pass
 9 through corresponding values....” Ex. 20 at p. 540. *See also id.* at p.
 10 364 (defining “in-phase” as “a state in which two or more periodic
 11 quantities ***having the same frequency and waveshape*** pass through
 12 corresponding values, such as maximas and minimas, at the same instant
 13 at all times.”)
- 14 • Modern Dictionary of Electronics (Ex. 21) defines the term “out-of-
 15 phase” as a “[r]elationship between periodic waves ***of the same***
 16 ***frequency***, but which do not pass through their maximum and
 17 minimum...values at the same instant.” Ex. 21 at p. 528. *See also id.* at
 18 p. 376 (defining “in phase” as “two waves ***of the same frequency*** that
 19 pass through their maximum and minimum values of like polarity at the
 20 same instant are said to be in phase.”)
- 21 • Penguin Dictionary of Electronics (Ex. 22) defines the term “phase” as
 22 “periodic quantities that ***have the same frequency and wave shape*** and
 23 that reach corresponding values simultaneously are said to be *in phase*;
 24 otherwise they are *out of phase*.” Ex. 22 at p. 431.

25
 26
 27 ² In addition to these definitions, Defendants have also submitted the declaration
 28 of Michael Gershowitz, which confirms that these definitions reflect the
 understanding of a POSITA at the relevant time. *See* Ex. 19 at ¶ 19.

- 1 • Chambers Dictionary of Science and Technology (Ex. 23) defines the
2 term “phase” as “[t]he fraction of the cycle of a periodic waveform...that
3 has been completed *at a specific reference time*, e.g. at the start of a
4 cycle of a second waveform *of the same frequency*.” Ex. 23 at p. 890.
- 5 • Collins Dictionary of Electronics (Ex. 24) defines the term “phase” as “a
6 time difference between two identical waveforms *of the same*
7 *frequency*.” Ex. 24 at p. 308.
- 8 • McGraw-Hill Dictionary of Scientific and Technical Terms 6th Edition
9 (Ex. 25) defines the term “out of phase” as “having waveforms that are
10 *of the same frequency* but do not pass through corresponding values at
11 the same instant.” Ex. 25 at p. 1503. *See also id.* at 1081 (defining “in
12 phase” as ‘having waveforms that are *of the same frequency* that pass
13 through corresponding values at the same instant).

14 Accordingly, Polaris’s new argument that “staggered” signals need not be
15 “identical” other than being phase-shifted, because they allegedly could also vary in
16 frequency, is entirely incorrect.

17 Notably, Polaris identifies no support in the ’148 patent for its position that
18 “out of phase” signals can have different frequencies. In fact, the ’148 patent’s
19 specification teaches to the contrary. For instance, Figure 4 of the ’148 patent depicts
20 the “out of phase” signals as having the same frequency. *Id.* at ¶ 10; *see also* Dkt.
21 69-1 at Fig. 4. And, while the specification of the patent does not define “in phase”
22 and “out of phase,” the ’148 patent specifies a single frequency for the signals it
23 describes, rather than multiple frequencies as Polaris contends. *See* Dkt. 69-1 at 4:37-
24 38 (“The PWM frequency should be above 100 Hz to avoid noticeable flicker in the
25 LEDs.”) A POSITA would have understood that this language is consistent with the
26 requirement of a single frequency for signals which are either “in phase” or “out of
27 phase” with each other. Ex. 19 at ¶ 20.

1 Dated: March 7, 2024

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ATTORNEY ATTESTATION

I, Zachariah Summers, am the ECF User whose ID and password are being used to file this stipulation. In compliance with Local Rule 5-4.3.4, I hereby attest that all other signatories listed, and on whose behalf the filing is submitted, concur in the filing's content and have authorized the filing.

Dated: March 7, 2024

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CERTIFICATE OF COMPLIANCE

The undersigned, counsel of record for VIZIO, AmTRAN Defendants, Top Victory Electronics Defendants, and Innolux Defendants, certifies that this brief contains 1151 words which complies with the word limit of L.R. 11-6.1 in the filing's content and have authorized the filing.

Dated: March 7, 2024

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EXHIBIT 19

IN THE UNITED STATES DISTRICT COURT
FOR THE CENTRAL DISTRICT OF CALIFORNIA

<p>POLARIS POWERLED TECHNOLOGIES, LLC</p> <p><i>Plaintiff,</i></p> <p>v.</p> <p>VIZIO, INC., HON HAI PRECISION INDUSTRY CO., LTD. D/B/A FOXCONN TECHNOLOGY GROUP, COMPETITION TEAM TECHNOLOGY USA INC., TOP VICTORY ELECTRONICS (TAIWAN) CO. LTD., TOP VICTORY INVESTMENTS LTD., TPV TECHNOLOGY LTD., TPV INTERNATIONAL (USA), INC., TREND SMART AMERICA, LTD., INNOLUX CORP., INNOLUX USA, INC., AMTRAN TECHNOLOGY CO., LTD., AMTRAN LOGISTICS, INC., and NEWEGG, INC.,</p> <p><i>Defendants.</i></p>	<p>Case No. 2:23-cv-03478</p>
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DECLARATION OF MICHAEL N. GERSHOWITZ IN SUPPORT OF
DEFENDANTS’ SUPPLEMENTAL RESPONSE

I. INTRODUCTION

1. My name is Michael Gershowitz. I have been asked to submit this declaration on behalf of Defendants in support of Defendants' Supplemental Response to Plaintiff's Responsive Claim Construction Brief.
2. As set forth in my Opening Declaration and Responsive Declaration, I have been retained as an expert by VIZIO. My experience and compensation, materials considered, understanding of the relevant legal principles, and initial opinions are set forth in those declarations, which I understand have already been submitted to the Court. I incorporate all sections from my Opening and Responsive Declarations as if they are set forth in full here.
3. Since submitting my previous declarations, I reviewed the Declaration of Thomas L. Credelle In Support of Plaintiffs' Responsive Claim Construction Brief. I also considered the additional materials discussed below—namely definitions of “phase” and its derivatives (*i.e.*, “in phase” and “out of phase”) (Exs. 20-25)—in forming my responsive opinions.
4. As before, my analysis as set out below is from the perspective of a person of ordinary skill in the art (“POSITA”).

II. THE '148 PATENT

A. Supplemental Opinions

5. In addition to the opinions set forth in my Opening and Responsive Declarations, I have been asked to provide my opinion on certain arguments in Mr. Credelle's responsive declaration.

1. Claims 1 and 14: “staggered PWM brightness control signals / staggered pulse width modulated (PWM) brightness control signals” (Terms 1 and 2)

Polaris's Construction	Defendants' Construction
Plain and ordinary meaning.	Identical but phase-shifted PWM brightness control signals.

6. Mr. Credelle addresses these terms in paragraphs 11 to 15 of his responsive declaration.
7. I have been asked to provide my opinion regarding two statements of Mr. Credelle in particular: (1) that the PWM signals described in claims 1 and 14 of the '148 patent may “have the same duty cycle but have different periods and be out of phase with each other” (Dkt. 72-1 at ¶ 11) and (2) that “the PWM pulses can be staggered in time and have the same duty cycle but have different frequencies.” *Id.* at ¶ 12.
8. In my opinion, both of these statements are incorrect and at odds with a POSITA's understanding of the claims and their description of the PWM signals as “out of phase.”

9. Specifically, Mr. Credelle is correct that the PWM brightness control signals described in the patent must be “out of phase with each other” as “required by claim 1” of the ’148 Patent. Dkt. 72-1 at ¶ 13. Claims 1 and 14 both require that the “staggered” PWM brightness control signals pass through “the plurality of current set circuits” and drive the “LEDs at the same duty cycle but out of phase with each other.”¹ Dkt. 69-1 at 6:51-54.
10. A POSITA would have understood, however, that for signals to be “out of phase,” they must have the same frequency. Specifically, a determination of “phase” requires signals to have the same frequency, so that a meaningful comparison can be made to determine if the various points in the signals’ waveform align (“in phase”) or do not align (“out of phase”). *See* definitions below. Signals are considered to be “in phase” with one another when they have the same corresponding values at any point in time whereas signals are considered to be “out of phase” when they do not. For instance, two rectangular pulse signals are “in phase” when their peaks and valleys align, whereas such signals are “out of phase” when they do not align. Indeed, as shown by Fig. 4 of the ’148 patent, the staggered signals are signals which have the same frequency

¹ Claim 14 recites that “the parallel paths of LEDs conduct current at substantially the same duty cycle but out of phase with each other.” The use of the word “substantially” does not alter my opinion on this issue and is addressed separately in my other declarations.

but are “out of phase” such that the same corresponding values of each signal do not align.

11. Signals at different frequencies are not described by POSITAs as “in” or “out of phase” because there is no meaningful way to determine whether the corresponding points in those signals match up (or align). *See* definitions below. Such signals do not have a “phase” relationship at all, and thus POSITAs do not describe them as “in phase” or “out of phase.”
12. In this regard, Mr. Credelle’s statement that two signals could be considered “in phase” or “out of phase” while having different frequencies is contradicted by the consistent description of the terms in contemporary electrical engineering dictionaries. As shown in Exs. 20-25 which are attached to this declaration, definitions from around the time of the patent explicitly specify that signals that are “in phase” or “out of phase” have the same frequencies and waveforms, consistent with the understanding of a POSITA.
13. For instance, Wiley Electrical and Electronics Engineering Dictionary defines the term “out-of-phase” as “a state in which two or more periodic quantities having the same frequency and waveshape do not pass through corresponding values....” Ex. 20 at p. 540; *see also id.* at p. 364 (defining “in-phase” as “a state in which two or more periodic quantities having the same frequency and

waveshape pass through corresponding values, such as maximas and minimas, at the same instant at all times.”)

14. Modern Dictionary of Electronics defines the term “out-of-phase” as a “[r]elationship between periodic waves of the same frequency, but which do not pass through their maximum and minimum...values at the same instant.” Ex. 21 at p. 528; *see also id.* at p. 376 (defining “in phase” as “two waves of the same frequency that pass through their maximum and minimum values of like polarity at the same instant are said to be in phase.”)
15. Penguin Dictionary of Electronics defines the term “phase” as “periodic quantities that have the same frequency and wave shape and that reach corresponding values simultaneously are said to be *in phase*; otherwise they are *out of phase*.” Ex. 22 at p. 431.
16. Chambers Dictionary of Science and Technology defines the term “phase” as “[t]he fraction of the cycle of a periodic waveform...that has been completed at a specific reference time, e.g. at the start of a cycle of a second waveform of the same frequency.” Ex. 23 at p. 890.
17. Collins Dictionary of Electronics defines the term “phase” as “a time difference between two identical waveforms of the same frequency.” Ex. 24 at p. 308.
18. McGraw-Hill Dictionary of Scientific and Technical Terms 6th Edition defines the term “out of phase” as “having waveforms that are of the same frequency

but do not pass through corresponding values at the same instant.” Ex. 25 at p. 1503; *see also id.* at 1081 (defining “in phase” as ‘having waveforms that are of the same frequency that pass through corresponding values at the same instant).

19. These definitions reflect the understanding of a POSITA at the time of the patent.

As they demonstrate, a POSITA reading the ’148 Patent would have understood that claims 1 and 14 require the “staggered” signals to be “out of phase,” and thus they cannot be different in frequency, contrary to Mr. Credelle’s arguments.

20. While the ’148 patent does not explicitly define the terms “in phase” or “out of phase,” I note that the ’148 Patent specification does indicate that the PWM brightness control signals have only a single frequency, rather than the multiple possible frequencies as Dr. Credelle contends. *See* Dkt. 69-1 at 4:37-38 (“The PWM frequency should be above 100 Hz to avoid noticeable flicker in the LEDs.”). A POSITA would have understood this language to confirm the requirement of a single frequency for signals either “in phase” or “out of phase” with each other. I further note that there is no support in the specification for Polaris’s view that staggered signals can have different frequencies. Figure 4, for instance, shows one frequency for each staggered signal.

III. CONCLUSION

21. I reserve the right to address further evidence and argument relating to my opinions expressed above to the extent identified to me.

22. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

DATED: March 7, 2024

By: _____


Michael N. Gershowitz

EXHIBIT 20

WILEY ELECTRICAL AND ELECTRONICS ENGINEERING DICTIONARY

Steven M. Kaplan
Lexicographer



IEEE PRESS



**WILEY-
INTERSCIENCE**

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Kaplan, Steven M.

Wiley Electrical and Electronics Engineering Dictionary

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Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1

impurity band In a semiconductor, an energy band arising from the presence of **impurities** (2).

impurity concentration In a semiconductor material, the number of **impurities** (2) present, per unit volume. Also called **impurity density**.

impurity density Same as **impurity concentration**.

impurity level 1. In a semiconductor, an energy level arising from the presence of **impurities** (2). 2. The extent to which **impurities** (2) are present in a semiconductor.

impurity scattering In a semiconductor, scattering of electrons off **impurities** (2).

impurity semiconductor A semiconductor material with introduced **impurities** (2), which determine its electrical characteristics, such as concentration of charge carriers. Also called **extrinsic semiconductor**, or **doped semiconductor**.

in 1. Abbreviation of **input**. 2. Abbreviation of **inch**.

In Chemical symbol for **indium**.

in-band signaling 1. In a telephone circuit, the transmission of control signals, such as dial tones and busy signals, via the same channel utilized for voice transmission. This contrasts with **out-of-band signaling**, in which a separate channel is used. 2. In data transmission, signaling in which the least significant bit is taken from the information stream and utilized for control signals and other overhead. Sometimes used over T1 or E1 lines. Also called **robbed-bit signaling**, or **bit robbing**.

in-circuit emulator A chip which emulates a given processor, and which serves for testing and debugging logic circuits. Its acronym is **ICE**.

in-circuit test A test performed on components without removing them from the circuit they are a part of.

in-circuit tester An instrument which tests components without removing them from the circuit they are a part of.

in-lb Abbreviation of **inch-pound**.

in-line code Same as **inline code**.

in-line graphics Same as **inline graphics**.

in-line image Same as **inline image**.

in-line tuning The tuning of all stages, such as those of an amplifier, to the same frequency. Also spelled **inline tuning**.

in parallel The connection of the components within a circuit in a manner that there are multiple paths among which the current is divided, while all the components have the same applied voltage. An example is the connection of components across each other. This contrasts with **in series**, where components are connected end-to-end, and in which there is a single path for the current. Also called **in shunt**, or **parallel connection**.

in-phase A state in which two or more periodic quantities having the same frequency and waveshape pass through corresponding values, such as maximas and minimas, at the same instant at all times. In an **out-of-phase** state, the periodic quantities do not pass through corresponding values at the same instant at all times.

in-phase component 1. Same as **in-phase current**. 2. Same as **in-phase voltage**.

in-phase current Within an AC circuit, the component of the current that is **in phase** with the voltage. Also known as **in-phase component** (1), **watt current**, **active current**, or **resistive current**.

in-phase rejection The ability of a differential amplifier to reject **in-phase signals**, while responding to signals which are not in phase. Also called **common-mode rejection**.

in-phase signal 1. For a differential device such as an amplifier, a signal applied equally to both inputs. Also called **common-mode signal** (1). 2. The algebraic average of two signals applied to both ends of a balanced circuit, such as that of a differential amplifier. Also called **common-mode signal** (2). 3. Same as **I signal**.

in-phase voltage Within an AC circuit, the component of the voltage that is **in phase** with the current. Also known as **in-phase component** (2), **resistive voltage**, or **active voltage**.

in quadrature Said of two periodic quantities having the same frequency and waveshape which are out-of-phase by 90°, or $\pi/2$ radians.

in/s Abbreviation of **inches per second**.

in series The end-to-end connection of the components within a circuit. There is a single path for the current, which flows through all the components in sequence, while the voltage is divided among the components. This contrasts with **in parallel**, where the connection is side-by-side, or otherwise in a manner where the current is divided among the components. Also called **series connection**.

in shunt Same as **in parallel**.

In-WATS Same as **Inward Wide-Area Telephone Service**.

Inaccuracy The quality or condition of being **inaccurate**.

inaccurate Incorrect, in error, or otherwise deviating from a real value. Said, for instance, of a measuring instrument.

inactive 1. Not ready for use, as in an unavailable communications channel. 2. Not currently functioning, as in a satellite which is not transmitting a signal at a given moment. 3. Not energized, as in a circuit that is not powered at the moment. 4. Chemically inert.

inactive application In a computer that has more than one application running, any application other than the one which is currently being interacted with.

inactive arm A component within a transducer that does not vary its electrical characteristics in response to the input of said transducer. Also called **inactive leg**.

inactive computer In a setting with two or more computers, any which is not currently processing.

inactive leg Same as **inactive arm**.

inactive lines In a TV, the lines that do not transmit the visible picture. These lines are above and below the visible picture. Also called **blanking lines**.

inactive window On a computer screen that has more than one window open, any window which is not currently being interacted with. There may be most any number of inactive windows, but there can only be one **active window**, which is the one which will be affected by such actions as keyboard input.

inbox In an email application, the default mailbox which to which incoming messages are directed. The default mailbox for outgoing messages is the **outbox**.

incandescence The emission of visible light by a heated object, such as the filament of an incandescent lamp. Also, the light emitted.

incandescent An object which when heated sufficiently emits visible light. Also, that which incorporates such an object.

incandescent lamp A lamp which incorporates a filament, often made of tungsten or carbon, which emits brilliant visible light when heated by an electric current. Such a lamp is what is commonly referred to as a **light bulb**.

inch A unit of distance equal to exactly 2.54 centimeters, or 0.0254 meters. Its abbreviation is **in**.

inch-pound A unit of work or energy equal to approximately 0.11299 joule. Its abbreviation is **in-lb**.

oscillography The use of an **oscilloscope** to observe and study one or more varying electrical quantities.

oscillometer A device utilized to measure and indicate oscillations.

oscilloscope Its abbreviation is **scope** (1). 1. An instrument which uses a CRT to produce visible patterns of one or more varying electrical quantities, or nonelectrical quantities, such as acoustic waves, with the assistance of a transducer. An oscilloscope typically displays variations in voltage plotted versus time, and may be used, for instance, to monitor signals such as brain waves. Also called **cathode-ray oscilloscope**. 2. An oscilloscope (1) which uses another type of display, such as an LCD or plasma display.

oscilloscope camera A camera specially adapted and fitted to an oscilloscope to produce oscillographs.

oscilloscope tube The CRT incorporated into an oscilloscope to produce visible patterns of one or more varying electrical signals.

oscilloscopic Pertaining to an oscilloscope.

OSD Abbreviation of **on-screen display**.

OSD display Same as **on-screen display**.

OSI Same as **OSI Reference Model**. Abbreviation of **Open Systems Interconnection**.

OSI Model Same as **OSI Reference Model**. Abbreviation of **Open Systems Interconnection Model**.

OSI Protocol Same as **OSI Reference Model**. Abbreviation of **Open Systems Interconnection Protocol**.

OSI Reference Model Abbreviation of **Open Systems Interconnection Reference Model**. An ISO standard which defines a seven-layer hierarchical structure for the implementation of communications protocols, with the goal of standardization of current networks along with component hardware and software, and providing guidance for the creation of future such networks and components. Each higher layer requests and depends on services from the lower layer adjacent to it. The lowest layer is the physical layer, or layer 1, followed by the data-link layer, or layer 2, then comes the network layer, followed by the transport layer, then comes the session layer, and then the presentation layer, and the highest is the application layer, or layer 7. Its own abbreviation is **OSI-RM**. Also known by various other names, including **OSI Model**, **OSI**, **OSI Protocol**, and **ISO-OSI Reference Model**.

OSI-RM Abbreviation of **OSI Reference Model**.

osmiridium A very hard alloy consisting mostly of osmium and iridium, and which also contains smaller quantities of platinum, rhodium, and ruthenium. It is used, for instance, in electrical contacts.

osmium A chemical element whose atomic number is 76. It is a bluish-white lustrous metal which is very hard, and whose density is approximately 22.61, which makes it, along with iridium, one of the two most dense elements. In addition, it is the most corrosion-resistant element, and has over 35 known isotopes, of which 5 are stable. Its applications include its use in hard alloys, and in instrument bearings. Its chemical symbol is **Os**.

osmosis For two solutions, each with different concentrations and separated by a partially permeable membrane, the process via which solvent molecules pass from one side to the other, without solute molecules passing.

OSP Abbreviation of **online service provider**.

OSPF Abbreviation of **Open Shortest Path First**.

OTA Abbreviation of **operational transconductance amplifier**.

OTDR 1. Abbreviation of **Optical Time Domain Reflectometer**. 2. Abbreviation of **Optical Time Domain Reflectometry**.

OTHR Abbreviation of **over-the-horizon radar**.

OTL Abbreviation of **output transformerless**.

OTP Abbreviation of **one-time programmable**.

OTPROM Abbreviation of **one-time PROM**. A PROM chip that can only be programmed once. Most PROM chips are of this type. This contrasts, for instance, with **EEPROM**, which can be rewritten multiple times.

ounce Its abbreviation is **oz**. 1. A unit of mass equal to approximately 0.0283495 kg. Also called **avoirdupois ounce**. 2. A unit of mass equal to approximately 0.0311035 kg. Also called **troy ounce**. 3. A unit of weight or force equal to the force of gravity on one ounce (1). This value varies by location, and is equal to approximately 0.278014 newtons. Also abbreviated **ozf**, which is more proper than **oz**. Also called **ounce force**.

ounce force Same as **ounce** (3).

out Abbreviation of **output**.

out-of-band Beyond, or otherwise located outside a given interval of frequencies.

out-of-band signaling In a telephone circuit, the transmission of control signals, such as dial tones and busy signals, utilizing a dedicated channel which is separate from any channels utilized for voice transmission. This contrasts with **in-band signaling** (1), in which in the same channel is utilized.

out-of-phase A state in which two or more periodic quantities having the same frequency and waveshape do not pass through corresponding values, such as maximas and minimas, at the same instant at all times. In an **in-phase** state, the periodic quantities pass through corresponding values at the same instant at all times.

out-of-phase component 1. Same as **out-of-phase current**. 2. Same as **out-of-phase voltage**.

out-of-phase current Within an AC circuit, the component of the current that is **out-of-phase** with the voltage. Also known as **out-of-phase component** (1).

out-of-phase signal A signal that is **out-of-phase** relative to another.

out-of-phase voltage Within an AC circuit, the component of the voltage that is **out-of-phase** with the current. Also known as **out-of-phase component** (2).

Out-WATS Abbreviation of **Outward Wide-Area Telephone Service**.

outage 1. An interruption or complete loss of AC power arriving from the power line. Also called **power outage** (1), or **power failure** (1). 2. An interruption or complete loss of power arriving from any source, such as a power line or generator. Also called **power outage** (2), or **power failure** (2). 3. An interruption or complete loss of a signal, such as that of a radio transmitter.

outbox In an email application, the default mailbox in which outgoing messages are stored. The default mailbox for incoming messages is the **inbox**.

outdiffusion The undesired diffusion of dopant atoms from a material with a higher doping level to that with a lower doping level, when sufficient heat is applied. This may occur, for instance, during the formation of epitaxial layers if the temperature is not properly maintained.

outdoor 1. Situated in the exterior of a building. 2. Designed for use in the exterior of a building, or outside of another enclosure which protects from surrounding weather.

outdoor antenna Also called **outside antenna**. 1. An antenna situated in the exterior of a building. 2. An antenna designed for use in the exterior of a building.

outdoor apparatus An apparatus designed for use in the exterior of a building, or outside of another enclosure which protects it from surrounding weather.

vasive computing may be used, for instance, to enable immediate access to computing tasks under nearly all circumstances, or for keeping track of innumerable objects and/or persons regardless of where they are. Also called **ubiquitous computing**.

perveance In an electron tube, a magnitude which determines the saturation current which can flow for a given geometry. It is a proportionality constant equal to $J/V^{3/2}$, where J is current density, and V is collector voltage. This value changes as a given tube ages.

PET Abbreviation of **positron emission tomography**.

PET scan Abbreviation of **positron emission tomography scan**.

PET scanner Abbreviation of **positron emission tomography scanner**.

peta- A metric prefix representing 10^{15} , which is equal to a quadrillion. For instance, 1 petahertz is equal to 10^{15} Hz, or 1,000,000,000,000,000 Hz. When referring to binary quantities, such as bits and bytes, it is equal to 2^{50} , or 1,125,899,906,842,624, although this is frequently rounded to 1,000,000,000,000,000. To avoid any confusion, the prefix **pebi-** may be used when dealing with binary quantities. Its abbreviation is **P**.

peta-electronvolt A unit of energy or work equal to 10^{15} electronvolts. Also spelled **petaelectronvolt**. Its abbreviation is **PeV**.

petabecquerel A unit of activity equal to 10^{15} becquerels. Its abbreviation is **PBq**.

petabit 2^{50} , or 1,125,899,906,842,624 bits, although this is frequently rounded to 1,000,000,000,000,000 bits. To avoid any confusion, the term **pebibit** may be used when referring to this concept. Its abbreviation is **Pb**, or **Pbit**.

petabits per second 2^{50} , or 1,125,899,906,842,624 bits, per second. Usually used as a measure of data-transfer speed. Its abbreviation is **Pbps**. To avoid any confusion, the term **pebibits per second** may be used when referring to this concept.

petabyte 2^{50} , or 1,125,899,906,842,624 bytes, although this is frequently rounded to 1,000,000,000,000,000 bytes. To avoid any confusion, the term **pebibyte** may be used when referring to this concept. Its abbreviation is **PB**, or **Pbyte**.

petabytes per second 2^{50} , or 1,125,899,906,842,624 bytes, per second. Usually used as a measure of data-transfer speed. Its abbreviation is **PBps**. To avoid any confusion, the term **pebibytes per second** may be used when referring to this concept.

petacycle A unit of frequency equal to 10^{15} cycles, or 10^{15} Hz. The term currently used for this concept is **petahertz**.

petaelectronvolt Same as **peta-electron volt**.

petaflops Same as **PFLOPS**.

petagram A unit of mass equal to 10^{15} grams. Its abbreviation is **Pg**.

petahertz A unit of frequency equal to 10^{15} Hz. Its abbreviation is **PHz**. Also called **petacycle**.

petajoule A unit of energy or work equal to 10^{15} joules. Its abbreviation is **PJ**.

petameter A unit of distance equal to 10^{15} meters. Its abbreviation is **Pm**.

petaohm Same as **petohm**.

petavolt A unit of potential difference equal to 10^{15} volts. Its abbreviation is **PV**.

petawatt A unit of power equal to 10^{15} watts. Its abbreviation is **PW**.

petohm A unit of resistance, impedance, or reactance equal to 10^{15} ohms. Its abbreviation is **PΩ**. Also spelled **petaohm**.

PeV Abbreviation of **peta-electronvolt**.

pF Abbreviation of **picofarad**.

PF Abbreviation of **power factor**.

PFC 1. Abbreviation of **power-factor correction**. 2. Abbreviation of **power-factor corrector**.

PFET Abbreviation of **p-channel FET**.

Pflops Same as **PFLOPS**.

PFLOPS Abbreviation of **petaflops**. 10^{15} FLOPS, which is the same as 10^{15} floating-point calculations or operations, per second. Usually used as a measure of processor speed.

PFM Abbreviation of **pulse-frequency modulation**.

pg Abbreviation of **picogram**.

Pg Abbreviation of **petagram**.

pG Abbreviation of **picogauss**.

PGA 1. Abbreviation of **programmable gate array**. 2. Abbreviation of **pin grid array**. 3. Abbreviation of **programmable gain amplifier**.

PgDn Abbreviation of **page down**.

PgDn key Abbreviation of **page down key**.

PGP Abbreviation of **Pretty Good Privacy**.

pGs Abbreviation of **picogauss**.

PgUp Abbreviation of **page up**.

PgUp key Abbreviation of **page up key**.

ph Abbreviation of **phot**.

pH 1. A measure of the acidity or alkalinity of a solution. For an aqueous solution it can be expressed as $\text{pH} = \log_{10}(1/H^+)$, where H^+ is the hydrogen-ion concentration. A pH of 7 is defined as neutral, below 7 is acidic, and above 7 is basic, or alkaline. It is an abbreviation of potential for hydrogen. Also called **pH value**. 2. Abbreviation of **picohenry**.

pH indicator 1. Same as **pH meter**. 2. An instrument, device, substance, or object, which indicates **pH values**. For instance, a powder or paper which changes color depending on whether a solution is acidic or alkaline.

pH meter An instrument or device, such as that utilizing a glass electrode, which serves to measure and indicate **pH values**. Also called **pH indicator (1)**.

pH scale A scale for expressing **pH (1) values**, which can range from 0 to 14. Since the scale is logarithmic, a pH of 1 is 100 times more acidic than a reading of 3, a pH of 11 is a thousand times more basic than a reading of 8, and so on.

pH value Same as **pH (1)**.

phantom channel In audio reproduction, a virtual channel created by two or more real channels. For instance, the use of left and right speakers to produce a center mono channel which is perceived by the listener as if there were a center speaker.

phantom circuit A third communications circuit, without a wire, derived from two circuits with wires which are appropriately coupled.

phantom signal A signal presented on a CRT, such as that of a radar or TV, whose origin can not be readily ascertained. For instance, that arising from a possible propagation anomaly which can not be pinpointed.

phantom target A resonant cavity that simulates a radar echo, by storing the energy of a transmitted pulse, and retransmitting it gradually to the radar receiver. Used for testing and tuning. Also known as **echo box**.

phase 1. Within a periodic phenomenon or process, a specified stage of progress. For instance, a moon phase. 2. For a given periodic phenomenon, process, or quantity, the portion of a complete cycle that has been completed, as measured from a given reference point. Two or more periodic quantities having the same frequency and waveshape that pass through corresponding values, such as maximas and minimas, at the same instant at all times are **in-phase**. While periodic quantities that do not pass through corresponding val-

ues at the same instant at all times are **out-of-phase**. A phase angle expresses the difference between the phases of two such quantities. Phase is usually expressed in degrees or radians, where a complete cycle is 360° or 2π , respectively. Its symbol is ϕ . 3. In a polyphase system, such as a three-phase AC circuit, one of the circuits. 4. In chemistry, a homogeneous region that can be observed and separated from another it is present with. For example, ice in water.

phase-alternate line Same as PAL (1).

phase-alternate line signal Same as PAL signal.

phase-alternate line standard Same as PAL standard.

phase-alternating line Same as PAL (1).

phase-alternating line signal Same as PAL signal.

phase-alternating line standard Same as PAL standard.

phase-alternation line Same as PAL (1).

phase-alternation line signal Same as PAL signal.

phase-alternation line standard Same as PAL standard.

phase angle For two periodic quantities with the same frequency, the difference between their respective phases. Expressed in radians or degrees. For example, the phase difference between an AC and the voltage producing it. Also known as **phase difference** (1), or **angular phase difference**.

phase-angle meter Same as **phase meter**.

phase-angle voltmeter A voltmeter which also indicates the phase angle of a measured voltage.

phase center For a given antenna, the apparent center of signal transmission or reception. This point varies, and depends, for instance, on the signal frequency. Also called **antenna phase center**.

phase change Same as **phase shift**.

phase-change coefficient Same as **phase constant**.

phase comparator Same as **phase detector**.

phase comparison Same as **phase detection**.

phase compensation The compensation of undesired phase differences. For example, the switching of capacitors in and out of a power-distribution network to compensate for variations in the power factor.

phase-compensation circuit An electric circuit utilized for **phase compensation**. Also called **phase-compensation network**.

phase-compensation network Same as **phase-compensation circuit**.

phase compensator A circuit, device, mechanism, or system utilized for **phase compensation**.

phase conductor In a polyphase circuit or system, a conductor other than a neutral conductor.

phase constant The imaginary number component of the propagation constant. The real part is the **attenuation constant**. Usually expressed in radians per unit length. Also called **phase-change coefficient**, or **wavelength constant**.

phase control Also called **phase-shift control** 1. A circuit, device, or mechanism utilized to vary the phase angle of a signal. 2. In a color TV receiver, a control which varies the phase of the chrominance signals with respect to the burst signal. This changes the hue of the televised images. Also called **hue control**.

phase converter A device which changes the number of phases of an AC source, without changing its frequency. For instance, a rotary converter whose input is 50 Hz single-phase 220VAC, and whose output is 50 Hz three-phase 220VAC.

phase correction The corrections a **phase corrector** makes. Also called **phase-delay equalization**, **phase equalization**, or **delay equalization**.

phase corrector A corrective network which serves to compensate for the effects of **phase distortion**. It may do so, for instance, by introducing the necessary delays at the appropriate frequencies to offset said distortion. Also called **phase-delay equalizer**, **phase equalizer**, or **delay equalizer**.

phase delay Also called **phase lag**, **phase difference** (2), or **phase displacement**. 1. For two periodic quantities with the same frequency, the lag in phase of one relative to the other. Expressed in radians or degrees. Also called **angle of lag**, or **lag angle**. 2. In the transmission of a single-frequency wave from one point to another through a transmission line or system, the time interval between the instants at which a given point of a wave passes through two specified points of said transmission medium.

phase-delay distortion Same as **phase distortion**.

phase-delay equalization Same as **phase correction**.

phase-delay equalizer Same as **phase corrector**.

phase detection The use of a **phase detector**. Also called **phase discrimination**, or **phase comparison**.

phase detector Its abbreviation is PD. Also called **phase discriminator**, **phase comparator**, **phase-sensitive detector**, or **phase-shift discriminator** (2). 1. A circuit, device, or instrument which detects any phase difference between two signals. 2. A circuit, device, or instrument which detects any phase difference between two signals, and whose output voltage is proportional to said difference.

phase-detector circuit A circuit utilized for **phase detection**.

phase deviation In phase modulation, the peak difference between the instantaneous phase angle of the modulated wave and that of the unmodulated carrier.

phase difference 1. Same as **phase angle**. 2. Same as **phase delay**.

phase discrimination Same as **phase detection**.

phase discriminator Same as **phase detector**.

phase displacement Same as **phase delay**.

phase distortion Distortion of a signal as it passes through a transmission medium in which different frequencies travel at slightly different speeds. This causes a change in the waveform because the rate of change of phase shift is not constant over the transmitted frequency range. Also called **phase-delay distortion**, **phase-frequency distortion**, **delay distortion**, **envelope delay distortion**, or **time-delay distortion**.

phase equalization Same as **phase correction**.

phase equalizer Same as **phase corrector**.

phase error Any defect or error caused by an undesired phase difference.

phase-frequency distortion Same as **phase distortion**.

phase inversion Also called **phase inverting**, **phase reversal**, or **phase reverting**. 1. A change in phase of 180° , or π radians, which is the same as a half-cycle. 2. A change in phase of 180° , or π radians, in an AC signal.

phase-inversion switch Same as **phase-reversal switch**.

phase inverter A circuit or device which changes the phase of a signal by 180° , or π radians. Used, for instance, to drive one side of a push-pull amplifier.

phase inverting Same as **phase inversion**.

phase jitter Small and rapid fluctuations in **phase** (2).

phase lag Same as **phase delay**.

phase-lock A technique utilized to make the phase of an oscillator signal follow the phase of a reference signal. The phase angles of the two signals are compared utilizing a phase detector, and the appropriate corrective adjustments are made.

EXHIBIT 21

**MODERN
DICTIONARY
of
ELECTRONICS**

SEVENTH EDITION

REVISED AND UPDATED

Rudolf F. Graf




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Boston Oxford Auckland Johannesburg Melbourne New Delhi


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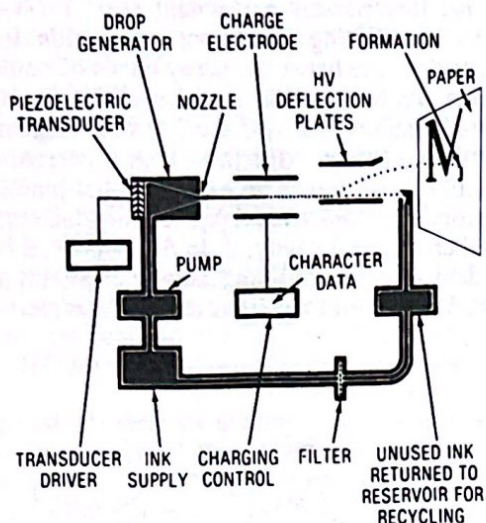
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ink-jet printer — input impedance

ink-jet printer—A nonimpact printer that forms letters and numbers by electrostatically aiming a jet of ink onto the paper.



Ink-jet printer.

ink-jet printing—A nonimpact printing technique that utilizes droplets of ink to form copy images. As the print head moves across the surface of the copy paper, it shoots a stream of tiny, electrostatically charged ink drops at the page, placing them precisely to form individual print characters.

ink-mist recording—Also called ink-vapor recording. In facsimile, electromechanical recording in which particles of an ink mist are deposited directly onto the record sheet.

ink recorder—The ink-filled pen or capillary tube that produces a graphic record.

ink recording—A type of mechanical facsimile recording in which an inked helix marks the record sheet.

ink-vapor recording—See ink-mist recording.

inleads—Those portions of the electrodes of a device that pass through an envelope or housing.

in-line heads—See stacked heads.

in-line procedures—1. In COBOL, the procedural instructions that are part of the main sequential and controlling flow of the program. 2. Short functions whose code is inserted by the compiler at the point of call, thereby avoiding the overhead of a normal function call.

in-line processing—The processing of data in random sequence not subject to preliminary sorting or editing.

in-line subroutine—A subroutine that is inserted directly into the linear operational sequence. Such a subroutine must be recopied at each point in a routine where it is needed.

in-line tuning—The method of tuning the intermediate-frequency strip of a superheterodyne receiver in which all the intermediate-frequency amplifier stages are made resonant to the same frequency.

inorganic electrolyte—A solution that conducts electricity due to the presence of ions of substances not of organic origin.

in phase—Two waves of the same frequency that pass through their maximum and minimum values of like polarity at the same instant are said to be in phase.

in-phase portion of the chrominance signal—That portion of the chrominance signal having the same phase as, or exactly the opposite phase from, that of the

subcarrier modulated by the I signal. This portion of the chrominance signal may lead or lag the quadrature portion by 90 electrical degrees.

input—1. The current, voltage, power or other driving force applied to a circuit or device. 2. The terminals or other places where current, voltage, power, or driving force may be applied to a circuit or device. 3. Data to be processed. 4. The process of transferring data from an external computer storage to an internal storage. 5. The terminals, jack, or receptacle provided for the introduction of an electrical signal or electric power into a device or system.

input admittance—1. The reciprocal of the input impedance. 2. The admittance between the input terminals with the outputs shorted together.

input area—In a computer, the area of internal storage into which data from external storage is transferred.

input bias current—1. The current that must be supplied to each input of an IC operational amplifier to assure proper biasing of the differential-input-stage transistors. In specification sheets, this term refers to the average of the two input bias currents. 2. One-half the sum of the separate currents entering the two input terminals of a balanced amplifier. 3. The average of the two input currents of an operational amplifier.

input block—In a computer, a section of the internal storage reserved for receiving and processing input data.

input capacitance—1. The capacitance at the input terminals of a device. 2. The capacitance between gate and source terminals of a field-effect transistor at specified bias and frequency conditions, with the drain ac short-circuited to the source.

input channel—A channel through which a state is impressed on a device or logic element.

input common-mode range—The maximum input that can be applied to either input of an operational amplifier without causing damage or abnormal operation.

input common-mode rejection ratio—1. The ratio of the change in input voltage to the corresponding change in output voltage, divided by the open-loop voltage gain. 2. The ratio of the full differential voltage gain to the common-mode voltage gain.

input common-mode voltage range—The range of voltages on the input terminals of an operational amplifier for which the amplifier is operational. Note that the specifications are not guaranteed over the full common-mode voltage range unless specifically stated.

input device—1. The device or set of devices through which data is brought into another device. 2. A device such as a card reader or terminal keyboard that converts data from the form in which it has been received into electronic signals that can be interpreted by the computer.

input equipment—The equipment that introduces information into a computer.

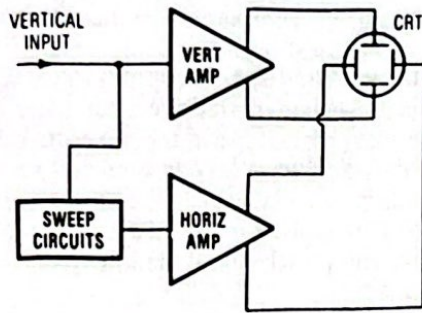
input error voltage—The error voltage appearing across the input terminals of an operational amplifier when a feedback loop is applied around the amplifier.

input extender—A high-speed diode array used in a logic circuit when increased fan-in capability is required.

input formatting—The technique a system uses to put all entered data into a standard (or intelligible) format.

input gap—Also called buncher gap. In a microwave tube, the gap where the initial velocity modulation of the electron stream occurs.

input impedance—1. The impedance a transducer presents to a source. 2. The effective impedance seen looking into the input terminals of an amplifier; circuit details, signal level, and frequency must be specified. 3. The impedance that exists between the input terminals

oscilloscope differential amplifier — output amplifier*Oscilloscope.*

of the instrument, the vertical deflection is a signal voltage and the horizontal deflection is a linear time base. 2. A cathode-ray tube with attendant amplifiers and control circuits for measuring and studying the waveforms of small currents and voltages. A CRT oscilloscope is particularly convenient for studying repetitive phenomena, but a tube with a long-delay phosphor can be used to analyze a single electrical pulse. An oscilloscope equipped with a camera (often of the instant type) becomes an oscillograph. 3. An electronic window that displays variations of voltage at any point in a circuit by displaying in graphic form on its screen the actual waveform of voltage plotted against time. In addition, an oscilloscope serves as an accurate ac/dc voltmeter and time-period counter. The typical scope is made up of five major interrelated parts: vertical amplifier section, horizontal amplifier section, sweep and synchronization circuits, picture tube (cathode-ray tube or CRT), and power supply. The electron beam strikes the fluorescent screen of the cathode-ray tube and temporarily produces a visible pattern or waveform of some fluctuating electrical quantity such as voltage. The pattern is employed to reveal the detailed variations in rapidly changing electric currents, potentials, or pulses.

oscilloscope differential amplifier—A device that amplifies and displays the voltage difference that exists at every instant between signals applied to its two inputs.

oscilloscope tube—Also called oscillograph tube. A cathode-ray tube that produces a visible pattern that is the graphical representation of electric signals. The pattern is seen as a spot or spots, which change position in accordance with the signals.

OSHA—Acronym for Occupational Safety and Health Act. A federal law that specifies the requirements an employer must follow in order to guard against employee illness and injury.

OSI—Abbreviation for Open Systems Interconnection. A layered architecture designed to permit interconnection between heterogeneous computer systems. Also, the international protocol for communications in a multiple-vendor environment.

OSO—Abbreviation for Orbiting Solar Observatory.

O-type backward-wave oscillator—A wide-band, voltage-tunable microwave oscillator that uses a fundamental or space harmonic with phase and group velocity of different signs.

outage—1. Loss of signal in a channel, usually the result of a dropout or a hit. 2. Status of equipment when it is out of service. Outages are termed *forced* when due to undesired occurrences, and *planned* when prescheduled, as for routine maintenance.

outconnector—In a flowchart, a connector indicating a point at which a flowline is broken to be continued at another point.

outdoor antenna—A receiving antenna located on an elevated site outside a building.

outdoor transformer—A transformer of weather-proof construction.

outer marker—In an instrument landing system, a marker located on a localizer course line at a recommended distance (normally about 4½ miles or 7.2 km) from the approach end of the runway.

outgas—The release of gas from a material over a period.

outgassing—1. A phenomenon in which a substance in a vacuum spontaneously releases absorbed and occluded constituents as vapors or gases. 2. De-aeration or other gaseous emission from a printed board assembly (printed board, component, or connector) when exposed to a reduced pressure or heat, or both.

outlet—1. The point where current is taken from a wiring system. 2. Convenience receptacle used for supplying power in the home, shop, or laboratory from power-company mains. 3. A point on the wiring system that can be tapped to provide electrical current for appliances or lights.

outlet box—Metal box that houses a switch or receptacle.

outline drawing—A drawing showing approximately overall shape, but no detail.

out of phase—1. Two or more waveforms that have the same shape, but do not pass through corresponding values at the same instant. 2. Relationship between periodic waves of the same frequency, but which do not pass through their maximum and minimum (or other corresponding) values at the same instant.

out-of-service jack—A jack, associated with a test jack, into which a shorted plug may be inserted to remove a circuit from service.

outphaser—In electronic organs, a circuit that changes a sawtooth wave to something approaching a square wave by adding to the sawtooth a second sawtooth of twice the frequency and half the amplitude in reverse phase, thus canceling the even harmonics.

outphasing—In electronic organs, a term applied to a method sometimes used for producing certain voices. Special circuitry, placed between the keying-system output and the formant filters, either adds or subtracts harmonics or subharmonics of the tone-generator signal.

output—1. The current, voltage, power, or driving force delivered by a circuit or device. 2. The terminals or other places where the circuit or device may deliver the current, voltage, power, or driving force. 3. Information transferred from the internal to the secondary or external storage of a computer. 4. The electrical quantity produced by a transducer, which is a function of the measurand. 5. The useful energy delivered by a circuit or device. 6. In logic circuits, frequently used to mean a change in condition between conducting and nonconducting. (It is like calling the coil of a relay the input and the contacts the output.) 7. The signal level at the output of an amplifier or other device. 8. A port or set of terminals at which a system or component delivers useful energy or a useful signal. Also the energy or signal delivered. The useful signal delivered by a recorder using a particular type of tape, usually at an arbitrarily fixed level of harmonic distortion (1 or 3 percent) and relative to the performance of a tape with standard characteristics. 9. The transfer of information from an information process. 10. The act of providing information from a device to the outside world. Generally accompanied by a device that inputs the information being output by the first device.

output amplifier—A circuit that energizes high-power-level devices upon application of a low-power-level input signal.

permeance coefficient—Also called demagnetizing coefficient. Describes operating conditions of a magnet and is the slope of the magnetic load line.

permissive control device—Generally a two-position, manually operated switch that in one position permits the closing of a circuit breaker or the placing of an equipment into operation, and in the other position prevents the circuit breaker or the equipment from being operated.

permittivity—1. See dielectric constant. 2. That property of a dielectric which determines the electrostatic energy stored per unit volume for a unit potential gradient.

permutation modulation—Proposed method of transmitting digital information by means of additive white Gaussian noise. Pulse-code modulation and pulse-position modulation are considered simple special cases of permutation modulation.

permutation table—In computers, a table for use in the systematic construction of code groups. It may also be used in the correction of garbles in groups of code text.

peroxide of lead—A lead compound that forms the principal part of the positive plate in a charged lead-acid cell.

perpendicular magnetization—In magnetic recording, magnetization that is perpendicular to the line of travel and parallel to the smallest cross-sectional dimension of the medium. Either single- or double-pole-piece magnetic heads may be used.

persistence—1. The length of time a phosphor dot glows on the screen of a cathode-ray tube before going out; i.e., the length of time it takes to decay from initial brightness (reached during fluorescence) until it can no longer be seen. 2. In a cathode-ray tube, the period that a phosphor continues to glow after excitation is removed.

persistence characteristic (of a luminescent screen)—Also called the decay characteristic. The relationship (usually shown by a graph) between the time a luminescent screen is excited and the time it emits radiant power.

persistence of vision—The physiological phenomenon whereby the eye retains a perception of an image for a short time after the field of vision has disappeared.

persistent current—A current that is magnetically induced and flows undiminished in a superconducting material or circuit.

persistor—A bimetallic circuit used for storage or readout in a computer. It is operated near absolute zero, and changes from a resistive to a superconductive state at a critical current value.

persistron—A device in which electroluminescence and photoconductivity are combined into a single panel capable of producing a steady or persistent display with pulsed signal input.

personal computer—Abbreviated PC. 1. A micro-computer that is designed to be used by a single user. 2. Self-contained, relatively small computer for individual users that contains all the hardware and software necessary to perform the required task(s).

persuader—In a storage tube, an element that directs secondary emission toward the electron-multiplier dynodes.

PERT—Acronym for program evaluation and review technique. A management tool for comparing actual with scheduled progress of a program.

perveance—The space-charge-limited cathode current divided by the three-halves power of the anode voltage in a diode.

petallized dish—A parabolic satellite signal receiving dish that is shipped in sections, or petals, and assembled at the installation site.

petticoat insulator—An insulator having an outward flaring lower part that is hollow to increase the length of the surface leakage path and keep part of the path dry at all times.

pF—Letter symbol for picofarad.

pg—Abbreviation for power gain.

p-gate thyristor—A thyristor in which the gate terminal is connected to the p-region nearest the cathode and which is normally switched to the on state by applying a positive signal between the gate and cathode terminals.

pH—A measure of the degree of acidity or alkalinity of a solution. In a neutral solution the pH value is 7. In acid solutions it ranges from 0 to 7, and in alkaline solutions it ranges from 7 to 14.

phanatron—An electronic circuit of the multivibrator type that is normally used in the monostable form. It is a stable trigger generator in this connection and is used in radar systems for gating functions and sweep-delay functions.

phanotron—A term used primarily in industrial electronics to mean a hot-cathode gas diode.

phantom—A signal derived from two sources in such a way as to appear located from a third source. Stereo signals “appearing” between speakers are said to be phantom.

phantom channel—In a stereo system, an electrical combination of the left and right channels fed to a third, centrally located speaker.

phantom circuit—A superimposed circuit derived from two suitably arranged pairs of wires called side circuits. Each pair of wires is a circuit itself, and at the same time acts as one conductor of the phantom circuit.

phantom-circuit loading coil—A loading coil that introduces the desired amount of inductance into a phantom circuit and a minimum amount into the constituent side circuits.

phantom-circuit repeating coil—A repeating coil used at a terminal of a phantom circuit, in the terminal circuit extending from the midpoints of the associated side-circuit repeating coils.

phantom coil—A coil originally used in a phantom circuit for impedance matching. Most generally, any coil, side or phantom, in a phantom circuit. When the term is used, the meaning should be made clear.

phantom group—1. A group of four open-wire conductors suitable for the derivation of a phantom circuit. 2. Three circuits that are derived from simplexing two physical circuits to form a phantom circuit.

phantom OR and AND—See wired OR.

phantom repeating coil—A side-circuit repeating coil or a phantom-circuit repeating coil, when discrimination between these two types is not necessary.

phantom signals—Signals appearing on the screen of a cathode-ray-tube indicator; their cause cannot readily be determined, and they may be due to circuit fault, interference, propagation anomalies, jamming, etc.

phantom target—See echo box.

phase—1. The angular relationship between current and voltage in alternating-current circuits. 2. The number of separate voltage waves in a commercial alternating-current supply (e.g., single-phase, three-phase, etc.). Symbolized by the Greek letter *phi* (ϕ). 3. In a periodic function or wave, the fraction of the period that has elapsed, measured from some fixed origin. If the time for one period is represented as 360° along a time axis, the phase position is called phase angle. 4. The relative timing of a signal in relation to another signal; if both signals occur at the same instant, they are in phase; if they occur at different instants, they are out of phase. 5. That part of a period through which the independent variable

has advanced, as measured from an arbitrary origin. 6. A particular stage, or point of advancement, in an electrical cycle. The fractional part of the period through which the time has advanced, measured from some arbitrary point, usually expressed in electrical degrees, where 360° represents one cycle. 7. The difference between the zero crossing or starting reference point between a standard waveform and the measured waveform. Phase is usually measured in degrees.

phase advancer—A phase modifier that supplies leading reactive volt-amperes to the system to which it is connected. Phase advancers may be either synchronous or nonsynchronous.

phase angle—1. Of a periodic function, the angle obtained by multiplying the phase by 2π if the angle is to be expressed in radians, or 360 for degrees. 2. The angle between the vectors representing two periodic functions that have the same frequency. 3. The phase difference, in degrees, between corresponding stages of progress of two cyclic operations. 4. The angle between two vectors that represent two simple periodic quantities that vary sinusoidally and that have the same frequency. 5. A notation for phase position when the period is denoted as 360.

phase-angle correction factor—That factor by which the reading of a wattmeter or watt-hour meter operated from the secondary of a current or potential transformer, or both, must be multiplied to correct for the effective phase displacement of current and voltage due to the measuring apparatus.

phase-angle measuring relay—Also called out-of-step protective relay. A device that functions at a predetermined phase angle between two voltages or currents, or between voltage and current.

phase-angle meter—See phase meter.

phase angle of a current transformer—The angle between the primary current vector and the secondary current vector reversed. This angle is conveniently considered as positive when the reversed secondary current vector leads the primary current vector.

phase angle of a potential (voltage) transformer—The angle between the primary voltage vector and the secondary voltage vector reversed. This angle is conveniently considered as positive when the reversed secondary voltage vector leads the primary voltage vector.

phase anomaly—A sudden irregularity in the phase of a low-frequency or very low frequency signal.

phase balance—In a chopper, the phase-angle difference between positive and negative halves of the square wave; the difference in degrees between 180° and the measured angle between square-wave midpoints.

phase-balance current relay—See reverse-phase current relay.

phase-balance relay—A relay that functions by reason of a difference between two quantities associated with different phases of a polyphase circuit.

phase center (center of radiation)—Pertaining only to antenna types that have radiation characteristics such that while they are radiating energy, one can observe the antenna from a distance of many wavelengths and see the energy radiating from a point within the antenna array. The position of a point-source radiator that would replace the antenna and produce the same far-field phase contour.

phase characteristic—A graph of phase shift versus frequency, assuming sinusoidal input and output.

phase comparator—See phase detector.

phase-comparison tracking system—A system that provides target-trajectory information by the use of cw phase-comparison techniques.

phase-compensation network—A network used to provide closed-loop stability in an operational amplifier. No greater than 12-dB/octave rolloff of the open-loop gain is allowed.

phase conductors—Those conductors other than the neutral conductor of a polyphase circuit.

phase constant—1. The imaginary component of the propagation constant. For a traveling plane wave at a given frequency, the rate in radians per unit length at which the phase lag of a field component (for the voltage or current) increases linearly in the direction of propagation. 2. With respect to a traveling plane wave at a known frequency, the space rate of decrease of phase of a field component in the direction of propagation, measured in radians per unit length.

phase control—Also called horizontal parabola control. 1. One of three controls for adjusting the phase of a voltage or current in a color television receiver employing the magnetic-convergence principle. Each control varies the phases of the sinusoidal voltages applied, at the horizontal-scanning frequency, to the coils of the magnetic-convergence assembly. 2. A technique for proportional control of an output signal by conduction only during certain parts of the cycle of the ac line voltage. 3. A method of regulating a supply of alternating current by use of a switching device such as a thyristor, by varying the point in each ac cycle or half-cycle at which the device is switched on.

phase-controlled rectifier—A rectifier circuit in which the rectifying element is a thyatron having a variable-phase sine-wave grid bias.

phase correction—The process of keeping synchronous telegraph mechanisms in substantially correct phase relationship.

phase corrector—1. A network designed to correct for phase distortion. 2. See pc, 2.

phased array—1. A group of simple radiating elements arranged over an area called an aperture. A beam (or beams) can be formed by superposition of the radiation from all the elements, and the direction of the beam can be adjusted by varying the relative phase of the signal applied to each element or by varying the frequency of the main oscillator. 2. An antenna consisting of a plurality of individual antennas, called elements, that are arrayed in a grid and interconnected so that a specific phase relationship exists between them, forming a narrow beam pattern for the reception of electromagnetic signals. 3. A technique of improving the gain of an antenna system by combining the outputs of several similar VHF/UHF/FM antennas in an array in such a way that the output signals from each one are exactly in phase with one another.

phase delay—1. In the transfer of a single frequency wave from one point to another in a system, the delay of part of the wave identifying its phase. 2. The insertion phase shift (in cycles) divided by the frequency (in cycles per second, or hertz). See also delay distortion, 2.

phase-delay distortion—The difference between the phase delay at one frequency and the phase delay at a reference frequency.

phase detector—Also called phase discriminator or phase comparator. 1. A TV circuit in which a dc correction voltage is derived to maintain a receiver oscillator in sync with some characteristic of the transmitted signal. 2. A circuit that detects both the magnitude and the sign of the phase angle between two sine-wave voltages or currents. 3. A circuit that creates an output level which is a function of the phase angle between two ac input signals. Most phase detectors are also amplitude sensitive. 4. A circuit that compares the relative phase between two inputs and produces an error voltage dependent on the difference. This error voltage corrects the VCO frequency

EXHIBIT 22

FOURTH EDITION

The Penguin Dictionary of
ELECTRONICS

Edited by Professor David Howard



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injection efficiency

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jection the number of excess carriers is comparable to the numbers at thermal equilibrium.

injection efficiency The efficiency of a p-n junction under forward bias, defined as the ratio of the current carried by injected minority carriers to the total current across the junction.

inkjet printer A device that prints text or graphical images onto paper or plastic film. The image is created by spraying ionized ink onto the paper or film. The ionized ink is directed by means of magnetized plates supplied by electric voltages that pull the ink according to the strength of voltage applied. This printing method is fast and able to produce very high-quality images. Printing quality of 600 dots per inch is now possible using this technology.

in parallel ►parallel.

in phase ►phase.

in-phase component 1. (of a current or voltage) ►active current; active voltage. 2. (of the volt-amperes) ►active volt-amperes.

input 1. The signal or driving force applied to a circuit, device, computer, machine, or other plant. 2. The terminals at which this signal is applied. 3. To apply as an input signal or driving force.

input impedance The ►impedance of a circuit or device presented at its input.

input/output (I/O) The passing of information into or out of the processing unit of a ►computer. Input devices include keyboards, pointing devices such as the mouse, document scanners, magnetic-card readers, and speech-recognition units. The most common output devices are printers and visual displays. ►Magnetic disks and ►magnetic tape are examples of media used for the recording and reading of data. An important function of most I/O equipment is the translation between the processor's signals and the symbols, actions, or sounds understood or generated by people.

in series ►series.

insertion gain ►insertion loss.

insertion loss The loss of power in a load that occurs when a network is inserted between the load and the generator supplying the load. *Insertion gain* occurs when a gain rather than a loss of power results. The loss or gain is usually expressed as the ratio of the power delivered to the load after insertion of the network, to the power delivered to the load before insertion; it is measured in ►nepers or ►decibels. The value usually depends not only on the network parameters but also on the load and generator impedances.

instantaneous automatic gain control A fast-acting automatic gain control in ►radar systems that reduces the ►clutter by responding very rapidly to variations in the mean clutter level.

O-type microwave tube *Syn. for linear-beam microwave tube.* ►microwave tube.

out of phase ►phase.

output 1. The power, voltage, or current delivered by any circuit, device, or apparatus. **2.** The part of any circuit, device, or apparatus, usually in the form of terminals, at which the power, voltage, or current is delivered. ►input/output. **3.** To deliver as an output signal.

output gap An ►interaction space in a ►microwave tube where power is extracted from the electron beam; it hence constitutes the output section of the tube.

output impedance The ►impedance presented at the output of an electronic circuit or device.

output transformer A transformer that is used for coupling an output circuit, particularly that of an amplifier, to the ►load.

overall efficiency The ratio of the power absorbed by the ►load of a device to the power supplied by the source.

overbunching ►velocity modulation.

overcoupling ►coupling.

overcurrent ►overcurrent release.

overcurrent release *Syn. overload release.* A switch, circuit-breaker, or other tripping device that operates when the current in a circuit exceeds a predetermined value. A current that causes the release to operate is an *overcurrent*.

The device is often designed so that a delay occurs after the overcurrent is sensed and before the device trips. Several different delay conditions can be used: *definite time lag* overcurrent release has a predetermined delay independent of the magnitude of the overcurrent; *inverse time lag* overcurrent release has a delay that is an inverse function of the magnitude of the overcurrent; *inverse and definite minimum time lag* overcurrent release occurs when the delay is an inverse function of the magnitude of the overcurrent until a minimum value of the delay is reached. ►undercurrent release.

overdamping *Syn. periodic damping.* ►damped.

overdriven amplifier An ►amplifier that is operated with an input voltage greater than that for which the circuit was designed. Overdriving results in ►distortion being introduced into the output waveform.

overflow The state in which a number is too large for the intended representation (for example, any value larger than 255 for an 8-bit binary representation).

overlay network In telephone or telecommunication systems, a network that is laid over the same geographic area as the basic network and provides a specific service or fulfils a specific function.

less than the persistence of the image on the human retina (about 0.1 seconds); it can however vary from fractions of a second to several years. 2. A faint luminosity observed after the passage of an electric discharge through certain gases; it can last for several seconds.

persistor A device, commonly in the form of a miniature bimetallic printed circuit, that depends for its operation on the sharp changes of resistance in a metal as it passes from a state of superconductivity to its normal resistive state. It can be used as a low-temperature storage element or very fast switch.

personal area network A network of communicating nodes with a geographical extent of one person. Typically, a hands-free headset might communicate with a mobile phone attached to the belt.

personal communications device >cellular communications.

personal computer A single-user computer commonly found in offices and homes.

Personal Computer Memory Card International Association >PCMCIA.

personal digital assistant (PDA) A small hand-held digital computer that provides the user with a range of facilities, usually including an electronic diary, contact and address list, web browser, and e-mail client. The PDA usually includes the facility to connect directly via a cable, infrared, or radio link to a computer so that information stored can be synchronized with the user's main personal computer.

perveance The space-charge-limited characteristic between the electrodes in an >electron tube. It is a function of the current density, j , and the collector voltage, V , being equal to $j/V^{3/2}$.

PFM *Abbrev. for* pulse-frequency modulation. >pulse modulation.

PGA *Abbrev. for* pin grid array.

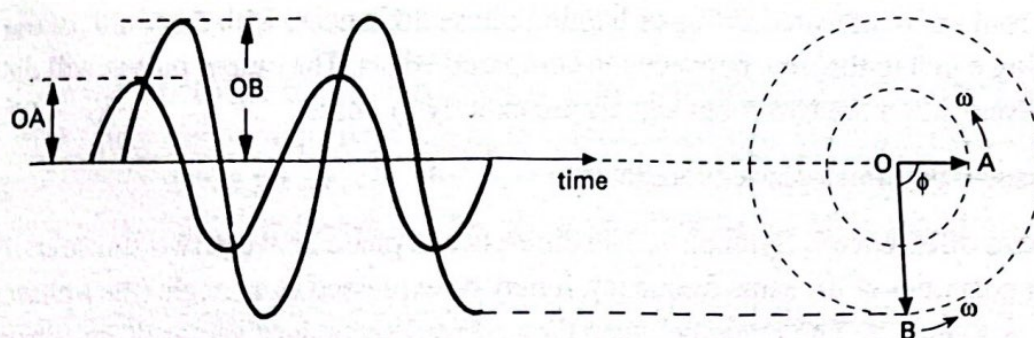
phase 1. The stage or state of development of a regularly recurring quantity; it is the fraction of the >period that has elapsed with respect to a fixed datum point.

The amplitude variations of a sinusoidally varying quantity are similar to simple harmonic motion; such a quantity may be represented as a rotating vector OA (see diagram) of length equal to the maximum amplitude and rotating through an angle 2π during the >period, T , of the waveform. The vector has an angular velocity, ω , equal to $2\pi/T$ and related to the frequency, f , of the waveform by

$$f = \omega/2\pi$$

The phase of the quantity OA with respect to another quantity, represented by the vector OB , is given by the angle, ϕ , between them (see diagram). This is the >phase angle (>phase difference), which is constant if the two quantities have the same frequency.

Particles in a travelling wavefront moving in the same direction with the same relative displacement are said to be in the same phase of vibration. The wavelength is equal



Phase angle between two quantities of the same frequency

to the distance travelled between two points, in the direction of propagation of a wavefront, at which the same phase recurs.

Periodic quantities that have the same frequency and wave shape and that reach corresponding values simultaneously are said to be *in phase*; otherwise they are *out of phase*. 2. One of the separate circuits or windings of a **polyphase system or apparatus**. 3. One of the lines or terminals of a **polyphase system or apparatus**.

phase angle Symbol: ϕ . The angle between two vectors that represent two sinusoidally varying quantities of the same frequency (**phase**). If the two quantities are nonsinusoidal but have the same **fundamental frequency**, the phase angle is the angle between the two vectors that represent the fundamental components. Waveforms that have a phase angle of $\pi/2$ are said to be in quadrature. If the phase angle is equal to π they are in antiphase.

phase centre A point on or near an antenna from which the radiated fields form spherical waves. In practice there may be no single point for radiation in all directions but there is usually a single point for the main radiated signal. In the case of a **broadband antenna**, the point is likely to move around depending on the frequency.

phase-change coefficient *Syns.* phase constant; wavelength constant. **propagation coefficient**.

phase constant *Syn. for* phase-change coefficient. **propagation coefficient**.

phase corrector A network that restores the original phase of a waveform that has suffered phase **distortion**.

phase delay The ratio of the inserted **phase shift** undergone by a periodic quantity to the frequency.

phase detector A device that compares two input frequencies, producing an output proportional to the difference in phase between them. If the two inputs differ in frequency, the output is a periodic signal at the difference frequency. There are two basic types of phase detector. Type I is designed to be driven by analogue or square-wave signals. This can be simply an **exclusive-OR gate** for the square-wave signals. Linear phase detectors use balanced **mixer circuits**. Type II is a detector sensitive to the relative timing of the rising or falling edges of the two digital inputs, producing out-

EXHIBIT 23

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inner cell mass (*BioSci*) A group of cells in the mammalian blastocyst that give rise to the embryo and are potentially capable of forming all tissues, embryonic and extra-embryonic, except the trophoblast. Abbrev *ICM*.

inner conductor (*ElecEng*) (1) See INTERNAL CONDUCTOR. (2) The neutral conductor of a three-wire system.

inner dead centre (*Eng*) Of a reciprocating engine or pump, the piston position at the beginning of the outstroke, ie when the crank pin is nearest to the cylinder. Also *top dead centre*.

inner-directed (*Psych*) A tendency to be guided by one's own principles rather than by external influences.

inner ear (*Med*) Structure encased in bone and filled with fluid, including the cochlea, the semicircular balancing canals and the vestibule.

inner forme (*Print*) In SHEET-WORK printing the imposition containing the second and second-last pages of the printed sheet, the *outer forme* containing the first and last pages and being printed on the other side.

inner glume (*BioSci*) Also *PALEA*.

inner marker beacon (*Aero*) A vertically directed radio beam which marks the airport boundary in a beam-approach landing system, such as the INSTRUMENT LANDING SYSTEM.

innervation (*BioSci*) The distribution of nerves to an organ.

innings (*CivEng*) Lands reclaimed from the sea. See *POLDER*.

innocent (*Med*) (1) Not malignant; not cancerous. See *TUMOUR*. (2) Type of heart murmur of no pathological significance.

innominate (*BioSci*) Without a name, eg the *innominate artery* of some mammals, which leads from the aortic arch to give rise to the carotid artery and the subclavian artery; the *innominate vein* of Cetacea, Edentata, Carnivora and primates, which leads across from the jugular-subclavian trunk of one side to that of the other; the *innominate bone*, which is the lateral half of the pelvic girdle.

inoculation (*BioSci*) (1) The introduction into an experimental animal, by various routes, of infected material or of pathogenic bacteria. (2) The injection of a vaccine into a person for protection against subsequent infection by the organisms contained in the vaccine, but also used loosely in immunology for the introduction of a substance into the body, usually by parenteral injection. (3) The placing of cells, spores, etc, on or in a potential host, soil or culture medium.

inoculation (*Chem*) The introduction of a small crystal into a supersaturated solution or supercooled liquid in order to initiate crystallization.

inoculation (*Eng*) The modification of crystallizing habit or grain refinement for imparting alloy qualities to molten metal in furnace or ladle, by addition of small quantities of other metals, deoxidants, etc.

inoculum (*BioSci*) The material used in inoculation.

Inorganic chemistry (*Chem*) The study of the chemical elements and their compounds, other than the compounds of carbon; however, the oxides and sulphides of carbon and the metallic carbides are generally included in inorganic chemistry.

inorganic polymers (*Chem*) Polymers whose chains are composed of atoms other than carbon. Many common materials contain such chains, eg silicate minerals, cement, where they perform an important reinforcement role. Chain bonds are Si-O (silicates), P-O (polyphosphates), P-N (phosphonitrilics), B-O (polyborates), etc. Silicone rubbers are of mixed lineage.

inosilicates (*Min*) Those silicate minerals which have an atomic structure in which the SiO_4 groups are linked together in chains, eg *PYROXENE GROUP*. See *SILICATES*.

inositol (*Chem*) *Cyclohexanhexol*, *hexahydroxycyclohexane*. $\text{C}_6\text{H}_6(\text{OH})_6$.

inositol trisphosphate (*BioSci*) Inositol 1,4,5 trisphosphate is an important second messenger released from phosphatidyl inositol bisphosphate in the cell membrane by the

action of a specific phospholipase C enzyme; binds to and activates a calcium channel in the endoplasmic reticulum.

inotropic (*BioSci*) Anything that alters the rate of heartbeat. Example: adrenaline has a positive inotropic effect and increases rate of beating.

in parallel (*ElecEng*) See *PARALLEL*.

in phase (*ElecEng*) See *PHASE*.

in-phase component (*ElecEng*) See *ACTIVE COMPONENT*.

in-phase loss (*ElecEng*) See *OHMIC LOSS*.

in-pile test (*NucEng*) One in which the effects of irradiation are measured while the specimen is subjected to radiation and neutrons in a reactor.

input (*ICT*) (1) Information entering a device, data about to be processed. (2) To enter information, to read in data.

input capacitance (*Phys*) The effective capacitance between the input terminals of a network. See *MILLER EFFECT*.

input characteristic (*Electronics*) See *TRANSISTOR CHARACTERISTICS*.

input device (*ICT*) *PERIPHERAL* that can accept data, presented in the appropriate machine-readable form, decode them and transmit them as electrical pulses to the *CENTRAL PROCESSING UNIT*.

input gap (*Electronics*) See *BUNCHER*.

input impedance (*ElecEng*, *Electronics*) The small signal impedance measured between the input terminals of a network.

input/output processor (*ICT*) Processor that supervises input-output operations. See *FRONT-END PROCESSING*.

input signal (*ElecEng*) That connected to the input terminals of any instrument or system (usually electronic).

input transformer (*ElecEng*) One used for isolating a circuit from any dc voltage in the applied signal and/or to provide a change in voltage. Also used to match the impedance of an input signal to that of the circuit to maximize power transfer.

input voltage (*ElecEng*, *Electronics*) The voltage applied between the input terminals of a network.

inquartation (*Eng*) Removal of silver from gold-silver bullion. The proportion of silver to gold must be raised by fusion to at least three to one, the silver being then dissolved in nitric acid. The silver can also be dissolved in concentrated sulphuric acid or converted to chloride by bubbling chlorine through the molten bullion. Also *parting of bullion*, *quartation*.

insanity (*Psych*) A medical legal term used in the defence of individuals who have committed crimes while their capacity for rational thought and behaviour was seriously impaired.

inscribed circle of a triangle (*MathSci*) The circle touching all three sides of a triangle internally. Its centre is the intersection of the bisectors of the angles of the triangle.

Insecta (*BioSci*) A class of mainly terrestrial mandibulate Arthropoda that breathe by tracheae. They possess uniramous appendages; the head is distinct from the thorax and bears one pair of antennae. There are three pairs of similar legs attached to the thorax, which may also bear wings. The body is sharply divided into head, thorax and abdomen. Also *Hexapoda*.

insecticides (*Chem*) Natural (eg derris, pyrethrins) or synthetic substances for destroying insects. The widely used synthetic compounds are broadly classified according to chemical composition as chlorinated (eg *DDT*), organophosphates (eg *MALATHION*), carbamates, dinitrophenols. Some of these have properties now considered undesirable, like persistence in *food chains*. Newer compounds like the modified pyrethrins have greater stability than the natural substance and still retain their effectiveness. See *CONTACT INSECTICIDE*, *FUMIGANTS*, *STOMACH INSECTICIDE*.

Insectivora (*BioSci*) An order of small, mainly terrestrial insectivorous mammals that have numerous sharp teeth, tuberculate molars, well-developed collar bones, and plantigrade ungulate pentadactyl feet. Shrews, moles and hedgehogs. Sometimes divided into two orders: *Lipotyphla* and *Menotyphla*.

outline font (ICT) A FONT built into a POSTSCRIPT-compatible printer.

outline letters (Print) Display types in which the outline only of the letter is shown; sometimes issued as part of a type family, but may also be a specifically designed type style on its own.

outliner (ICT) A facility available in many WORD PROCESSORS and DESKTOP PUBLISHING programs allowing the structure of a document including page formats, chapters, headings and TYPEFACES to be defined before the main body of the text is written.

out of balance (Eng) Said of a rotating machine element which is imperfectly balanced, or of a mechanism or machine which contains such an element.

out-of-band signalling (ICT) Signalling in a telephone system by using either an additional speech channel or signals within the user channel but just outside the normal speech band of 300 Hz–3.4 kHz; a typical frequency is 3.825 kHz.

out of phase (ElecEng, ICT) See PHASE.

out of wind (Build) A term applied to a flat surface; a plane surface which is not twisted, timber free from warp or twist.

output (ICT) (1) Information leaving a device, data resulting from processing. (2) To give out information, to print or transfer to auxiliary storage the data resulting from processing. (3) Audio, electric or mechanical signal delivered by instrument or system to a load.

output capacitance (Electronics) (1) The capacitive component of the output impedance or transducer, amplifier, or other circuit or device. (2) The anode-cathode capacitance of a thermionic valve.

output characteristic (Electronics) See TRANSISTOR CHARACTERISTICS.

output coefficient (ElecEng) See SPECIFIC TORQUE COEFFICIENT.

output device (ICT) Peripheral that translates signals from the computer into a human-readable form or into a form suitable for reprocessing by the computer at a later stage.

output gap (Electronics) An interaction gap through which an output signal can be withdrawn from an electron beam.

output impedance (ElecEng) That presented by the device to the load and which determines REGULATION (voltage drop) of source when current is taken. In a linear source, the backward impedance when the emf is reduced to zero. Also *source impedance*. See THÉVENIN'S THEOREM.

output meter (ElecEng) That which measures output voltage of an oscillator, amplifier, etc. Calibrated in VOLTS, or POWER LEVEL in dB in relation to ZERO POWER LEVEL (1 milliwatt) when circuit is properly terminated. See VOLUME UNIT.

output noise (Genrl) See THERMAL NOISE.

output regulation (ElecEng) Of a power supply, the variation of voltage with load current.

output transformer (ElecEng) One which couples the last stage in an amplifier to the load, eg a loudspeaker or line.

output valve (Electronics) One designed for delivering power to a load, eg line or loudspeaker, voltage gain not being relevant. Final stage of any multivalve amplifier.

output winding (ElecEng) That from which power is withdrawn in a transformer, transductor or magnetic amplifier.

outrigger (Build) (1) A projecting beam carrying a suspended scaffold. (2) Timbers built across a gable end to hold a rafter for a projecting verge.

outset (Print) A section placed on the outside of the main section, and sometimes called a 'wrap round'.

outside crank (Eng) An overhung or single-web crank attached to a crankshaft outside the main bearings.

outside cylinders (Eng) The steam cylinders carried outside the frame of a locomotive, working onto crank pins in the driving wheels.

outside gouge (Build) A firmer gouge having the bevel ground upon the convex side of the cutting edge.

outside lap (Eng) The amount by which the slide valve of a steam engine overlaps the edge of the steam ports when in mid-position. Also *steam lap*.

outside lining (Build) The external member of a cased frame.

outside loop (Aero) See INVERTED LOOP.

out-takes (ImageTech) TAKES of scenes photographed and printed for a production but not used in the finally edited version.

out-to-out (Build) A term applied to an overall measurement across a piece of framing.

outturn sheet (Paper) A representative sample sheet of a particular batch of paper.

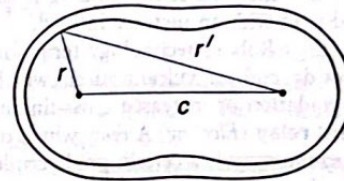
outwash fan (Geol) A sheet of gravel and sand, lying beyond the margins of a sheet of till, deposited by meltwaters from an ice sheet or glacier.

ova (BioSci) Pl of OVUM.

ovalbumin (Chem) Same as EGG ALBUMEN.

oval pistons (Autos) (1) Pistons, originally round, worn oval through friction at the thrust faces. (2) Pistons purposely turned slightly oval, to compensate for the unequal diametral expansion.

ovals of Cassini (MathSci) Curves defined by the bipolar equation $rr' = k$. Each consists of either two ovals, one surrounding each reference point, or a single oval surrounding both reference points, according as $k < c$ or $k > c$ respectively, where c is the distance between the two reference points. If $k = c$, it reduces to the LEMNISCATE OF BERNOULLI.



ovals of Cassini Drawn for two values of k .

oval window (BioSci) See FENESTRA OVALIS.

ovarian (Med) Pertaining to or connected with the ovary.

ovarian follicle (BioSci) In mammals the group of cells around the primary oocyte proliferate and produce a surrounding non-cellular layer. A space opens up in the follicle cells and the whole structure is then the *Graafian follicle*.

ovariectomy (Med) Surgical removal of one or both ovaries.

ovariole (BioSci) In insects, one of the egg tubes of which the ovary is composed.

ovary (BioSci) (1) A female gonad; a reproductive gland producing ova. (2) The hollow structure, the basal part of a carpel or of a syncarpous gynoecium, that contains the ovules. (3) Also *pistil*. Adj *ovarian*.

ovate (BioSci) Egg-shaped with the broadest part nearer to the point of attachment.

oven-dry paper (Paper) See BONE-DRY PAPER.

oven-type furnace (Eng) Industrial heat-treatment furnace fired under the hearth, the live gases flowing directly into the heating chamber through live-gas flues disposed along each side of the hearth. Also *semimuffle-type furnace*.

overall echo loudness rating (ICT) A measure of physical echo suppression in a mobile-telephone system, the sum of two components, both expressed in DECIBELS: the weighted terminal coupling loss of the near-end terminal, representing the isolation between earpiece and microphone of the handset; and the overall loudness rating of the far-end terminal.

overall efficiency (ElecEng) The ratio of useful output to total input power.

overall luminous efficiency (Phys) The ratio of luminous flux of a lamp to total energy input. Not to be confused with LUMINOUS EFFICIENCY.

phagotrophy (*BioSci*) Heterotrophic nutrition in which cells ingest solid food particles.

-phago (*Genrl*) See PHAG-.

phalanges (*BioSci*) In vertebrates, the bones supporting the segments of the digits; fiddle-shaped rings composing the reticular lamina of the organ of Corti. Sing *phalanx*.

Phalangida (*BioSci*) See OPILIONES.

phalanx (*BioSci*) See PHALANGES.

phalaris staggers (*Vet*) A nervous disease of sheep in Australia caused by eating the grass *Phalaris tuberosa*; believed to be caused by a toxic substance in the grass when eaten by cobalt-deficient sheep.

phallic stage (*Psych*) In psychoanalytic theory, the third stage of psychosexual development in which the child is preoccupied with his or her genitals; from the third to fifth or sixth year of life. See ELECTRA COMPLEX, OEDIPUS COMPLEX.

phallus (*BioSci*) The penis of mammals; the primordium of the penis or clitoris of mammals. Adj *phallic*.

phanero- (*Genrl*) Prefix from Gk *phaneros*, visible.

phanerocrystalline (*Min*) Said of an igneous rock in which the crystals of all the essential minerals can be discerned by the naked eye.

phanerophyte (*BioSci*) Woody plant with perennating buds more than 25 cm above the soil surface. See RAUNKIAER SYSTEM.

Phanerozoic (*Geol*) The span of *obvious life*. More precisely the unit of geological time that comprises the Palaeozoic, Mesozoic and Cenozoic eras. See appendix on Geological time.

phantasy (*Psych*) See FANTASY.

phantom antenna (*ICT*) See ARTIFICIAL ANTENNA.

phantom limb (*Psych*) Sensations that appear to arise from an amputated limb that is still neurologically represented in the brain.

phantom material (*Radiol*) That producing absorption and back-scatter of radiation very similar to human tissue, and hence used in models to study appropriate doses, radiation scattering, etc. A phantom is a reproduction of (part of) the body in this material. Also *tissue equivalent material*.

phantom ring (*Phys*) The coloured ring of light which appears to surround an observer's shadow when the shadow falls on an extended bank of fog or cloud.

pharate (*BioSci*) In insects, refers to a phase of development when the old cuticle of one stage is separate from the hypodermis of the next stage, but has not yet been ruptured and cast off. The 'pupa' of many insects actually represents a pharate adult and the 'prepupa' a pharate pupa.

pharmacodynamics (*Pharmacol*) The biochemical and physiological processes determining the effects of drugs on organisms. See PHARMACOKINETICS.

pharmacogenetics (*Pharmacol*) The study of genetic causes of individual variations in drug response; the term is often used interchangeably with PHARMACOGENOMICS.

pharmacogenomics (*Pharmacol*) Genome-wide analysis of the genetic determinants of drug efficacy and toxicity rather than individual genetic differences (polymorphisms). Often used interchangeably with PHARMACOGENETICS.

pharmacokinetics (*Pharmacol*) The pharmacokinetics of a drug relate to the rate and extent of uptake (absorption), transformation as a result of metabolism, the distribution of the drug and its metabolites in the tissues, the metabolic breakdown of the drug and the elimination of the drug or its metabolites from the body (excretion). Commonly abbreviated as ADME.

pharmacolite (*Min*) A hydrated arsenate of calcium which crystallizes in the monoclinic system. It is a product of the late alteration of mineral deposits which carry arsenopyrite and the arsenical ores of cobalt and silver.

pharmacology (*Genrl*) The scientific study of the action of chemical substances on living systems. The subject field is

used in this dictionary for drugs and pharmacologically active substances used in medicine.

pharmacosiderite (*Min*) Hydrated arsenate of iron. It crystallizes in the cubic system, and is a product of the alteration of arsenical ores.

pharming (*BioSci*) The commercial production of substances from transgenic plants or animals for medical (pharmaceutical) use.

pharming (*ICT*) The covert redirection of computer users from legitimate websites to counterfeit sites in order to gain confidential information about them. By analogy with PHISHING.

pharyngismus (*Med*) Spasm of the muscles of the pharynx.

pharyngitis (*Med*) Inflammation of the pharynx.

pharyngoplasty (*Med*) The surgical alteration, or reconstruction, of the pharynx in congenital and acquired disease.

pharyngoplegia (*Med*) Paralysis of the muscles of the pharynx.

pharyngotomy (*Med*) Incision into the pharynx.

pharynx (*BioSci*) In vertebrates, that portion of the alimentary canal between the mouth and the oesophagus which serves both eating and respiration; in invertebrates, the corresponding portion of the alimentary canal lying immediately posterior to the buccal cavity, usually having a highly muscular wall. Adj *pharyngeal*.

phase (*Astron*) Of the Moon, the name given to the changing shape of the visible illuminated surface of the Moon due to the varying relative positions of the Earth, Sun and Moon during the synodic month. Starting from new Moon, the phase increases through crescent, first quarter, gibbous, to full Moon, and then decreases through gibbous, third quarter, waning to new Moon again. The inferior planets show the same phases, but in the reverse order; the superior planets can show a gibbous phase, but not a crescent.

phase (*Chem*) (1) The sum of all those portions of a material system which are identical in chemical composition and physical state, and are separated from the rest of the system by a distinct interface called the *phase boundary*. (2) The particular state of a substance, as a solid, liquid or gas.

phase (*ElecEng, ICT*) The fraction of cycle of a periodic waveform (usually sinusoidal) that has been completed at a specific reference time, eg at the start of a cycle of a second waveform of the same frequency. Expressed as an angle, one cycle corresponds to 2π radians or 360° . The terms *in phase*, *in quadrature* and *antiphase* correspond to phase angles between two signals of 0° (or 360°), 90° and 180° respectively. See POLYPHASE, SINGLE PHASE, TWO PHASE, THREE PHASE.

phase advancer (*ElecEng*) A component connected in the secondary circuit of an induction motor to improve its POWER FACTOR.

phase-amplitude modulation (*ICT*) An efficient modulation scheme widely used for data transmission over telephone channels, in which two carriers of the same frequency but differing in phase by 90° are independently modulated by AMPLITUDE SHIFT KEYING. The result is a signal constellation consisting typically of 16 points in phase-amplitude space. Also *quadrature amplitude modulation*.

phase angle (*ElecEng, ICT*) See PHASE. Also given by δ , where $\tan \delta = (\text{reactance/resistance})$ for an ac circuit or an acoustic system.

phase change (*Eng*) See PHASE TRANSITION.

phase compensation (*ICT*) See LINE EQUALIZER.

phase constant (*ICT*) Imaginary part of propagation constant of a line, or of the transfer constant of a filter section. It is expressed in radians per unit length or section. See IMAGE PHASE CONSTANT.

phase-contrast microscopy (*BioSci*) A simple non-quantitative form of interference microscopy of great utility in visualizing live cells. Small differences in optical path

EXHIBIT 24

 **Collins** • DICTIONARY

Electronics

DEFINITIONS FOR THE DIGITAL AGE

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2. the supply of a signal from an OSCILLATOR into a MIXER. **3.** the introduction of CARRIERS (sense 2) into a SEMICONDUCTOR.

Inkjet printer a form of non-impact printer that uses a MATRIX of fine jets to squirt ink at the paper. The ink cartridge and the set of jets can be made as one unit so that clogging of the jets is avoided by changing the jets along with the ink-cartridge. The advantages include fairly high speed, silent operation, high resolution (600–1200 or more dots per inch) and the ability to form any character shape and to execute high-resolution graphics. In addition, colour ink-jet printers can be made at little more initial cost than the monochrome version, though running costs are higher. Two main types use different principles to control the ink flow. The bubblejet™ system, devised by Canon, uses heating elements in a microscopically fine tube to evaporate ink, creating a bubble that then displaces ink through the jet. The Stylus™ system, devised by Epson, uses a piezoelectric (see PIEZOELECTRIC CRYSTAL) tube that constricts, squirting ink, when acted on by an applied voltage.

inner coding a digital television process that uses modulation and transmission of two separate data streams to ensure redundancy for error correction before other (outer) coding methods are applied. See also CONVOLUTIONAL CODING; VITERBI CODING.

in-phase component **1.** the portion of a signal VOLTAGE that is in PHASE with current, or the portion of a signal CURRENT that is in phase with voltage. **2.** or

I component the CHROMINANCE SIGNAL component in the NTSC colour TV system that is in PHASE with its SUBCARRIER. See also QUADRATURE COMPONENT (Q component).

input **1.** a SIGNAL taken into a component or system. Contrast OUTPUT. **2.** the connections to which the input signal is applied.

input attenuator, cro the switched POTENTIOMETER (sense 1) at the input of the Y-AMPLIFIER of a CATHODE-RAY OSCILLOSCOPE that is used to prevent a large signal overloading the amplifier.

Input capacitance the capacitance, usually STRAY CAPACITANCE, at the input of a circuit which will have an attenuating effect on high-frequency signals.

Input characteristic the graph of current plotted against voltage (or *vice-versa*) at the input of an electronic component, particularly a SEMICONDUCTOR device.

Input current the DC or signal current at the input of a device, which for a logic device can be a DC SINK (sense 1) or SOURCE (sense 3) current.

Input impedance the IMPEDANCE at the input terminals of a device, generally expressed by a COMPLEX NUMBER.

Input node a point where signals enter an electronics circuit.

Input offset the very small difference between DC levels at the two inputs of an OPERATIONAL AMPLIFIER with a BALANCED POWER SUPPLY, that will result in the output being at zero potential.

Input/output (I/O) the parts of a computer circuit that deal with the INPUT (sense 1) or OUTPUT of signals.

Input/output controller a form of INTERFACE found on the larger computers, that controls the paths between the computer and its peripherals. This allows the peripherals to be used more efficiently, and speeds up the action of the main computer. Some types of input/output controller incorporate both memory and a separate MICROPROCESSOR. They can therefore free the main processor from carrying out input or output steps. See also DMA.

Input resistance the ratio of voltage to IN-PHASE current (for AC or DC) at the input of an electronic device.

Inrush rating the current rating for a changeover action on a heavy-duty RELAY.

Insertion gain the GAIN of an amplifier when it is placed between a source of SIGNAL and a LOAD. The figure is usually expressed in decibels.

Insertion loss the loss of SIGNAL power due to a NETWORK (sense 1) placed between a source of signal and a LOAD. The figure is usually expressed in decibels.

oscillator, quartz crystal see CRYSTAL OSCILLATOR.

oscillator, relaxation see RELAXATION OSCILLATOR.

oscillator, superhet see LOCAL OSCILLATOR.

oscillator, tape erase/bias see TAPE BIAS; TAPE ERASE.

oscillator, triangle wave see TRIANGLE WAVE OSCILLATOR.

oscillator, twin-T see TWIN-T OSCILLATOR.

oscillator, voltage controlled see VOLTAGE CONTROLLED OSCILLATOR

oscillator, Wien bridge see WIEN BRIDGE OSCILLATOR.

oscillator, Schmitt trigger see SCHMITT TRIGGER OSCILLATOR.

oscillator, unijunction see UNIJUNCTION OSCILLATOR.

oscilloscope see CATHODE-RAY OSCILLOSCOPE.

oscilloscope, digital storage see DIGITAL STORAGE OSCILLOSCOPE (DSO).

oscilloscope probe see PROBE (sense 1).

OSD on-screen display: the appearance on the screen of a TV receiver of information relating to a VIDEO CASSETTE RECORDER, DVD RECORDER, SET-TOP BOX, or other setting-up information.

OSI see OPEN SYSTEMS INTERCONNECT.

OTHR see OVER THE HORIZON RADAR.

OTP see ONE-TIME PROGRAMMABLE.

outer coding or outer code the REED-SOLOMON CODING of a DIGITAL DATA stream prior to other processes such as INTERLEAVING and INNER CODING.

outgassing the removal of absorbed gas from the metal, ceramic and glass of a THERMIONIC VALVE. This is done by eddy current heating while the valve is being evacuated. At later stages, outgassing can be assisted by running the valve filament and possibly passing ANODE current. Transmitting valves use no GETTER to absorb traces of gas, so it is particularly important to perform the outgassing very thoroughly while the valve is still connected to the vacuum pumps.

out-of-phase signal a signal whose phase is not in PHASE with respect to another signal. Out of phase is sometimes used to imply that the signal is INVERTED, but the

two shapes are not identical for signals other than sine waves.

out of service testing the testing of equipment using artificially injected signals as distinct from making measurements on equipment that is still in use.

output the final signal-delivering STAGE of an electronic circuit. Contrast INPUT (sense 2).

output characteristic a graph plotting output current against output voltage for a circuit or device.

output current the current delivered by a device or absorbed by a device at its output.

output fuse a FUSE placed between an audio OUTPUT STAGE and a LOUDSPEAKER to protect the loudspeaker against excessive current. The fuse must be securely mounted to avoid variations in resistance.

output gap the part of a MICROWAVE device from which the microwave signal is taken.

output impedance the ratio of signal voltage to current, usually expressed as a COMPLEX NUMBER from which amplitude and phase can be obtained, at the OUTPUT of a DEVICE or CIRCUIT.

output level the AMPLITUDE of signal from a device (such as a tapehead or disc CARTRIDGE, sense 2) under standard conditions.

output meter a METER that can be connected to the OUTPUT of a CIRCUIT to measure the power at the output.

output offset voltage the value of output voltage of an OPERATIONAL AMPLIFIER when both input terminals are earthed.

output power the amount of power that a circuit can deliver to a load, usually quoted in watts, either for DC or for a sine wave. See also MUSIC POWER.

output regulation see REGULATION.

output resistance the ratio of signal voltage to signal current at the output of a device or circuit.

output stage or output the final signal-delivering stage of an electronic circuit.

output transformer a TRANSFORMER that is used at the OUTPUT of a CIRCUIT for COUPLING and IMPEDANCE MATCHING.

electromagnetic waves in that medium.

See PERMEABILITY OF FREE SPACE.

permutation decoding a procedure for correcting errors in a word for which several PARITY errors have been discovered. This operates by shifting the bits in the received word and re-computing parity until agreement is found.

persistence the phenomenon of light being emitted from a PHOSPHOR screen after being struck by electrons or other radiation. See AFTERGLOW; LONG-PERSISTENCE SCREEN.

persistent memory see NONVOLATILE MEMORY.

Personal Computer (PC) the type of computer design using the design principles embodied in the IBM Personal Computer in 1982, and developed into the principles now used by a vast number of manufacturers. See EISA; ISA.

Personal Computer Memory Card

International Association (PCMCIA)

a standardizing agency whose initials are used for any memory storage card (or PC card) initially designed for plugging into laptop computers, and now also used on some DIGITAL CAMERAS. Other plug-in devices such as MODEMS and HARD DRIVES can be manufactured to make use of the same connecting system.

perveance a characteristic of a vacuum THERMIONIC VALVE. Perveance measures the DC conductivity of the valve per unit area of cross section of the ANODE.

PES see PROGRAMME ELEMENTARY STREAM.

peta a prefix denoting (for computing purposes) the number 2^{50} , so that one petabyte is equal to 1024 terabytes (see TERA). The prefix is also used outside computing applications for 10^{15} which is a lower number.

pet alley a VOLUMETRIC DETECTION zone in a security system that is close to ground level to allow small animals to move without triggering an alarm.

petabyte 2^{50} bytes.

PFM see PULSE-FREQUENCY MODULATION.

P-frame a form of predicted frame (sense 1) in an MPEG-2 set, accounting for three of

the frames in a set of twelve. The information in a P-frame is predicted from the preceding adjacent I-FRAME or B-FRAME. See also GROUP OF PICTURES.

pH a logarithmic scale for measuring acidity, in terms of the logarithm of the concentration of hydrogen ions in a solution. Neutral conditions are indicated by a pH of 7, acidity by lower numbers and alkalinity by higher numbers (up to 15).

phase a time difference between two identical WAVEFORMS of the same FREQUENCY. Phase difference is expressed either as a fraction of a cycle or, more usually, as a phase angle found by expressing the phase as a fraction of the cycle time and multiplying this figure by 360. If the phase angle is to be expressed in radians, the time fraction must be multiplied by 2π . When the term is used to denote a single wave, the phase angle between current and voltage is meant.

phase accumulator a form of COUNTER used in a digital FREQUENCY SYNTHESIZER to establish phase.

phase alternate line see PAL.

phase and amplitude modulation the equivalent of amplitude modulating (see AMPLITUDE MODULATION a CARRIER (sense 1) with one signal at 0° phase and with another signal at 90° phase. See also QUADRATURE DEMODULATOR.

phase coincidence detector or PCD

a form of DEMODULATOR for frequency modulated (see FREQUENCY MODULATION) signals that operates on a GATING system, not necessarily requiring any tuned circuit.

phase comparator the circuit that compares the PHASE of a signal input with the phase of a LOCAL OSCILLATOR and provides an output that is proportional to the phase difference between them.

phase constant the PHASE SHIFT per unit length of a TRANSMISSION LINE.

phase control a method of using a THYRISTOR to control power in an AC circuit. In a phase-control system, the point of switching on the thyristor in each cycle can be varied with respect to the phase of the voltage.

phase correction circuit a circuit that restores the original PHASE (of voltage relative to current) of a signal to compensate for the effect of another network.

phased array aerial (or antenna) or scanning array an AERIAL array in which the PHASE between elements can be changed so as to alter the direction of maximum sensitivity of the aerial without mechanical adjustment.

phase delay the amount of PHASE SHIFT per unit frequency of a wave.

phase deviation the difference in PHASE ANGLE of a phase-modulated wave compared to a standard (reference) phase. See PHASE MODULATION.

phase difference the difference in PHASE between two waves expressed in terms other than PHASE ANGLE, e.g. time difference or fraction of a cycle.

phase discriminator or phase-sensitive detector or phase detector or phase-sensitive demodulator a form of demodulator for phase-modulated signals (see PHASE MODULATION). The phase discriminator produces an output voltage that is proportional to the phase difference between the input signal and a reference signal.

phase displacement aerial (or antenna) any type of aerial that uses a single driven element along with a group of reflectors, such as the YAGI.

phase distortion the unwanted PHASE DIFFERENCE between current and voltage of a waveform. Phase distortion is caused by the presence of reactive components in the current path.

phase function for an AERIAL (antenna), a mathematical function that relates the PHASE of the ELECTROMAGNETIC FIELD to that of a theoretically perfect spherical field form.

phase inverter 1. a signal waveform inverter, such as an INVERTING AMPLIFIER.
2. a circuit that changes the phase of a signal by 180° . In common usage, the term usually denotes sense 1, but sense 2 is the more correct definition.

phase-inverted signals a pair of signals of which one is the inverse of the other,

typically used as the input to a BALANCED AMPLIFIER.

phase-linear (of a system) having a response in which PHASE plotted against FREQUENCY forms a straight line graph.

phase-locked loop a CIRCUIT in which the PHASE of a LOCAL OSCILLATOR is locked to the phase of an incoming signal (see LOCK-IN). This implies that the frequencies of the two signals are also equal. The locking action is carried out by using a PHASE DISCRIMINATOR to generate a signal proportional to the phase difference between the signals, and then using this signal to correct the oscillator frequency until phase equality is reached.

phase modulation (PM) the MODULATION of the PHASE of a CARRIER (sense 1) by a SIGNAL. The phase change of the carrier is made proportional to the amplitude of the modulating signal. The carrier amplitude remains constant, and the frequency of the variation is the same as the frequency of the modulating signal. The effect of phase modulation is indistinguishable from that of FREQUENCY MODULATION.

phase noise the effect of a noisy OSCILLATOR signal on a MIXER stage producing noisy SIDEBANDS in the sum or difference signal.

phaser a circuit used in an electronic SYNTHESIZER to add a delayed phase shifted signal to the original signal to produce a frequency sweeping effect.

phase response for a circuit, the PHASE ANGLE of output relative to input.

phase reversal keying (PRK) see PHASE SHIFT KEYING.

phase-sensitive demodulator see PHASE DISCRIMINATOR.

phase-sensitive detector see PHASE DISCRIMINATOR.

phase shift a change in the relative PHASES of two quantities; the term usually denotes a change in the phase of voltage relative to current in a single wave.

phase shift, capacitive a phase shift of 90° with current leading voltage, as would be caused by a capacitor in a circuit.

phase shift, inductive a phase shift of 90° with voltage leading current, as would be caused by an inductor in a circuit.

EXHIBIT 25

**McGRAW-HILL
DICTIONARY OF
SCIENTIFIC AND
TECHNICAL
TERMS**

Sixth Edition

McGraw-Hill

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On the cover: Representation of a fullerene molecule with a noble gas atom trapped inside. At the Permian-Triassic sedimentary boundary the noble gases helium and argon have been found trapped inside fullerenes. They exhibit isotope ratios quite similar to those found in meteorites, suggesting that a fireball meteorite or asteroid exploded when it hit the Earth, causing major changes in the environment. (Image copyright © Dr. Luann Becker. Reproduced with permission.)

Over the six editions of the Dictionary, material has been drawn from the following references: G. M. Garrity et al., *Taxonomic Outline of the Prokaryotes*, Release 2, Springer-Verlag, January 2002; D. W. Linzey, *Vertebrate Biology*, McGraw-Hill, 2001; J. A. Pechenik, *Biology of the Invertebrates*, 4th ed., McGraw-Hill, 2000; U.S. Air Force Glossary of Standardized Terms, AF Manual 11-1, vol. 1, 1972; F. Casey, ed., *Compilation of Terms in Information Sciences Technology*, Federal Council for Science and Technology, 1970; *Communications-Electronics Terminology*, AF Manual 11-1, vol. 3, 1970; P. W. Thrush, comp. and ed., *A Dictionary of Mining, Mineral, and Related Terms*, Bureau of Mines, 1968; *A DOD Glossary of Mapping, Charting and Geodetic Terms*, Department of Defense, 1967; J. M. Gilliland, *Solar-Terrestrial Physics: A Glossary of Terms and Abbreviations*, Royal Aircraft Establishment Technical Report 67158, 1967; W. H. Allen, ed., *Dictionary of Technical Terms for Aerospace Use*, National Aeronautics and Space Administration, 1965; *Glossary of Stinfo Terminology*, Office of Aerospace Research, U.S. Air Force, 1963; *Naval Dictionary of Electronic, Technical, and Imperative Terms*, Bureau of Naval Personnel, 1962; R. E. Huschke, *Glossary of Meteorology*, American Meteorological Society, 1959; *ADP Glossary*, Department of the Navy, NAVSO P-3097; *Glossary of Air Traffic Control Terms*, Federal Aviation Agency; *A Glossary of Range Terminology*, White Sands Missile Range, New Mexico, National Bureau of Standards, AD 467-424; *Nuclear Terms: A Glossary*, 2d ed., Atomic Energy Commission.

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inner hearth

harbor generally has additional protection and is often the principal berthing area. { 'in-ər 'här-bər }

inner hearth See back hearth. { 'in-ər 'härth }

inner keel [NAV ARCH] The inner plate of a double, flat plate keel. { 'in-ər 'kēl }

inner Lagrangian point [ASTRON] A Lagrangian point that lies between two primary bodies on the line passing through their centers of mass, and through which mass transfer may occur between them. Also known as conical point. { 'in-ər lə'grän-jē-ən ,pɔɪnt }

inner mantle See lower mantle. { 'in-ər 'mant-əl }

inner marker [NAV] A 75-megahertz marker beacon normally used with the instrument landing system (ILS) to indicate that the aircraft is over the boundary of the airport. { 'in-ər 'mär-kər }

inner measure See Lebesgue interior measure. { 'in-ər 'mez-ər }

inner planet [ASTRON] Any of the four planets (Mercury, Venus, Earth, and Mars) in the solar system whose orbits are closest to the sun. { 'in-ər 'plan-ət }

inner potential [SOLID STATE] The average value of the electrostatic potential, taken over the volume of a crystal. { 'in-ər pə'ten-ʃənl }

inner product [MATH] 1. A scalar valued function of pairs of vectors from a vector space, denoted by (x,y) where x and y are vectors, and with the properties that (x,x) is always positive and is zero only if $x = 0$, that $(ax + by, z) = a(x, z) + b(y, z)$ for any scalars a and b , and that $(x, y) = (y, x)$ if the scalars are real numbers, $(x, y) = \overline{(y, x)}$ if the scalars are complex numbers. Also known as Hermitian inner product; Hermitian scalar product. 2. The inner product of vectors (x_1, \dots, x_n) and (y_1, \dots, y_n) from n -dimensional euclidean space is the sum of $x_i y_i$ as i ranges from 1 to n . Also known as dot product; scalar product. 3. The inner product of two functions f and g of a real or complex variable is the integral of $f(x)\overline{g(x)}dx$, where $\overline{g(x)}$ denotes the conjugate of $g(x)$. 4. The inner product of two tensors is the contracted tensor obtained from their product by means of pairing contravariant indices of one with covariant indices of the other. { 'in-ər 'präd-əkt }

inner product space [MATH] A vector space that has an inner product defined on it. Also known as generalized Euclidean space; Hermitian space; pre-Hilbert space. { 'in-ər 'präd-əkt ,spās }

inner quantum number [ATOM PHYS] A quantum number J which gives an atom's total angular momentum, excluding the nuclear spin. { 'in-ər 'kwänt-əm ,nəm-bər }

inner strake [NAV ARCH] The inner part of an in and out system of shell plating; the strakes adjacent to the molded frame line. { 'in-ər 'strāk }

inner tube [ENG] A rubber tube used inside a pneumatic tire casing to hold air under pressure. Also known as tube. [MIN ENG] The inside tube which acts as the core container of a double-tube core barrel; used to obtain core samples for analysis of an ore formation. Also known as inner barrel. { 'in-ər ,tüb }

inner-tube extension See lifter case. { 'in-ər ,tüb ik'sten-ʃən }

innervation [ANAT] The distribution of nerves to a part. [PHYSIO] The amount of nerve stimulation received by a part. { 'in-ər'vā-shən }

innominate See hipbone. { 'in-əm-ə-nət }

innominate artery [ANAT] The first artery branching from the aortic arch; distributes blood to the head, neck, shoulder, and arm on the right side of the body. { 'in-əm-ə-nət 'ärd-ə-rē }

inoculant [MET] A substance which augments a melt, usually in the latter part of the melting operation, thus altering the solidification structure of the cast metal, as in grain refinement of aluminum alloys. { 'in-äk-yə-länt }

inoculation [BIOL] Introduction of a disease agent into an animal or plant to produce a mild form of disease and render the individual immune. [MET] Treating a molten material with another material before casting in order to nucleate crystals. [MICROBIO] Introduction of microorganisms onto or into a culture medium. { 'in-äk-yə-lä'shən }

inoculum [MICROBIO] A small amount of substance containing bacteria from a pure culture which is used to start a new culture or to infect an experimental animal. { 'in-äk-yə-ləm }

in-pile loop

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Inoperculate [BIOL] Lacking an operculum. { 'in-ä'pər-kyə-lət }

Inorganic [INORG CHEM] Pertaining to or composed of chemical compounds that do not contain carbon as the principal element (excepting carbonates, cyanides, and cyanates), that is, matter other than plant or animal. { 'in-ör'gan-ik }

Inorganic acid [INORG CHEM] A compound composed of hydrogen and a nonmetal element or radical; examples are hydrochloric acid, HCl, sulfuric acid, H₂SO₄, and carbonic acid, H₂CO₃. { 'in-ör'gan-ik 'as-əd }

Inorganic biochemistry See bioinorganic chemistry. { 'in-ör, gan-ik ,bi-ō'kem-ə-strē }

Inorganic chemistry [CHEM] The study of chemical reactions and properties of all the elements and their compounds, with the exception of hydrocarbons, and usually including carbides, oxides of carbon, metallic carbonates, carbon-sulfur compounds, and carbon-nitrogen compounds. { 'in-ör'gan-ik 'kem-ə-strē }

Inorganic chert [PETR] Chert derived from siliceous colloids precipitated from silica-saturated waters. { 'in-ör'gan-ik 'chert }

Inorganic liquid laser [OPTICS] A liquid laser in which an inorganic liquid such as neodymium-selenium oxychloride or neodymium-doped phosphorus chloride is used as the active material. Also known as neodymium liquid laser. { 'in-ör'gan-ik 'lik-wəd 'lä-zər }

Inorganic peroxide [INORG CHEM] An inorganic compound containing an element at its highest state of oxidation (such as perchloric acid, HClO₄), or having the peroxy group, -O-O- (such as perchromic acid, H₃CrO₈·2H₂O). { 'in-ör'gan-ik pə'räk,sīd }

Inorganic pigment [INORG CHEM] A natural or synthetic metal oxide, sulfide, or other salt used as a coloring agent for paints, plastics, and inks. { 'in-ör'gan-ik 'pig-mənt }

Inorganic polymer [INORG CHEM] Large molecules, usually linear or branched chains with atoms other than carbon in their backbone; an example is glass, an inorganic polymer made up of rings and chains of repeating silicate units. { 'in-ör'gan-ik 'päl-ə-mər }

Inosculation See anastomosis. { 'in,äs-kyə'lä-shən }

Inosilicate [GEOL] A class or structural type of silicate in which the SiO₄ tetrahedrons are linked together by the sharing of oxygens to form linear chains of indefinite length. { 'in-ō'sil-ə,kāt }

Inosine [BIOCHEM] C₁₀H₁₂N₄O₅ A compound occurring in muscle; a hydrolysis product of inosinic acid. { 'in-ə,sēn }

Inosinic acid [BIOCHEM] C₁₀H₁₃N₄O₈P A nucleotide constituent of muscle, formed by deamination of adenylic acid; on hydrolysis it yields hypoxanthine and D-ribose-5-phosphoric acid. { 'in-ə'sin-ik 'as-əd }

Inositol [ORG CHEM] C₆H₆(OH)₆·2H₂O A water-soluble alcohol often grouped with the vitamins; there are nine stereoisomers of hexahydroxycyclohexane, and the only one of biological importance is optically inactive *meso*-inositol, comprising white crystals, widely distributed in animals and plants; it serves as a growth factor for animals and microorganisms. { 'in-äs-ə,töl }

Inoviridae [VIROL] A family of nontailed bacterial viruses (bacteriophages) characterized by a nonenveloped rod-shaped virion containing a single-stranded circular deoxyribonucleic acid genome. { 'ē-nō'vir-ə,dē }

Inovirus [VIROL] A genus of bacterial viruses of the family Inoviridae that are characterized by semiflexible filamentous virions with helical symmetry. { 'In-ə,vī-rəs }

In phase [PHYS] Having waveforms that are of the same frequency and that pass through corresponding values at the same instant. { 'in ,fāz }

In-phase component [ELEC] The component of the phasor representing an alternating current which is parallel to the phasor representing voltage. { 'in ,fāz kəm'pō-nənt }

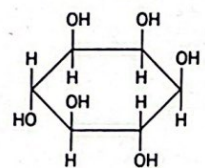
In-phase rejection See common-mode rejection. { 'in ,fāz ri'jek-shən }

In-phase signal See common-mode signal. { 'in ,fāz 'sig-nəl }

In-pile [NUCLEO] Referring to experiments or equipment inside a reactor. { 'in ,pil }

In-pile loop [NUCLEO] An experiment inserted directly in a nuclear reactor (pile) incorporating a closed circuit (loop) of fluid usually for cooling purposes. { 'in ,pil ,lūp }

INOSITOL



Structural formula for inositol.

outlet box

power can be obtained by inserting the plug of a line cord. Also known as convenience receptacle; electric outlet; receptacle. { 'aüt,let }

outlet box [ELEC] A box at which lines in an electric wiring system terminate, so that electric appliances or fixtures may be connected. { 'aüt,let ,bäks }

outlet glacier [HYD] A stream of ice from an ice cap to the sea. { 'aüt,let ,glä-shör }

outlet head [HYD] The place where water leaves a lake and enters an effluent. { 'aüt,let ,hed }

outlet ventilator See louver. { 'aüt,let 'vent-äl,äd-ör }

outlier [GEOL] A group of rocks separated from the main mass and surrounded by outcrops of older rocks. [STAT] In a set of data, a value so far removed from other values in the distribution that its presence cannot be attributed to the random combination of chance causes. { 'aüt,li-ör }

outline font See scalable font. { 'aüt,lín ,fánt }

outline map [MAP] A map that presents minimal geographic information, usually only coastlines, principal streams, major civil boundaries, and large cities, leaving as much space as possible for the addition of specific data. { 'aüt,lín ,map }

outline processor [COMPUT SCI] A software system that organizes notes in ordinary English into an outline that serves as the basis for a document. { 'aüt,lín ,präs-es-ör }

out-of-line coding [COMPUT SCI] Instructions in a routine that are stored in a different part of computer storage from the rest of the instructions. { 'aüt öv 'lín 'kód-ín }

out of phase [PHYS] Having waveforms that are of the same frequency but do not pass through corresponding values at the same instant. { 'aüt öv 'fäz }

out-of-service jack [ELEC] Jack associated with a test jack which removes the circuit from service when a shorted plug is inserted. { 'aüt öv 'sör-väs 'jak }

outpatient [MED] A patient who comes to the hospital or clinic for diagnosis and treatment but who does not occupy a bed in the institution. { 'aüt,pä-shönt }

out-plant system [COMPUT SCI] A data-processing system that has one or more remote terminals from which information is transmitted to a central computer. { 'aüt ,plant ,sis-töm }

output [COMPUT SCI] 1. The data produced by a data-processing operation, or the information that is the objective or goal in data processing. 2. The data actively transmitted from within the computer to an external device, or onto a permanent recording medium (paper, microfilm). 3. The activity of transmitting the generated information. 4. The readable storage medium upon which generated data are written, as in hard-copy output. [ELECTR] 1. The current, voltage, power, driving force, or information which a circuit or device delivers. 2. Terminals or other places where a circuit or device can deliver current, voltage, power, driving force, or information. [SCI TECH] The product of a system. { 'aüt,püt }

output area [COMPUT SCI] A part of storage that has been reserved for output data. Also known as output block. { 'aüt ,püt ,er-ä-ä }

output block [COMPUT SCI] 1. A portion of the internal storage of a computer that is reserved for receiving, processing, and transmitting data to be transferred out. 2. See output area. { 'aüt,püt ,bläk }

output-bound computer [COMPUT SCI] A computer that is slowed down by its output functions. { 'aüt,püt ,bäund kəm,pyüd-ör }

output bus driver [ELECTR] A device that power-amplifies output signals from a computer to allow them to drive heavy circuit loads. { 'aüt,püt 'bäs ,drfv-ör }

output capacitance [ELECTR] Of an *n*-terminal electron tube, the short-circuit transfer capacitance between the output terminal and all other terminals, except the input terminal, connected together. { 'aüt,püt kə,päs-äd-öns }

output class [COMPUT SCI] An indicator of the priority of output from a computer that determines the order in which it is printed from a spool file. { 'aüt,püt ,klas }

output device See output unit. { 'aüt,püt di,vīs }

output gap [ELECTR] An interaction gap by means of which usable power can be abstracted from an electron stream in a microwave tube. { 'aüt,püt ,gap }

output impedance [ELECTR] The impedance presented by a source to a load. { 'aüt,püt im,péd-öns }

output indicator [ENG] A meter or other device that is connected to a radio receiver to indicate variations in output signal

strength for alignment and other purposes, without indicating the exact value of output. { 'aüt,püt ,in-dä,käd-ör }

output-limited [ENG] Restricted by the need to await completion of an output operation, as in process control or data processing. { 'aüt,püt ,lim-äd-äd }

output link [COMMUN] The last link in a communications chain. { 'aüt,püt ,línk }

output meter [ENG] An alternating-current voltmeter connected to the output of a receiver or amplifier to measure output signal strength in volume units or decibels. { 'aüt,püt ,méd-ör }

output-meter adapter [ENG] Device that can be slipped over the plate prong of the output tube of a radio receiver to provide a conventional terminal to which an output meter can be connected during alignment. { 'aüt,püt ,méd-ör ä,dap-tör }

output monitor interrupt [COMPUT SCI] A data-processing step in which control is passed to the monitor to determine the precedence order for two requests having the same priority level. { 'aüt,püt ,man-äd-ör 'int-ör,rəpt }

output power [ELEC] Power delivered by a system or transducer to its load. { 'aüt,püt ,pau-ör }

output program See output routine. { 'aüt,püt ,prō,gram }

output rating See carrier power output rating. { 'aüt,püt ,räd-ín }

output record [COMPUT SCI] 1. A unit of data that has been transcribed from a computer to an external medium or device. 2. The unit of data that is currently held in the output area of a computer before being transcribed to an external medium or device. { 'aüt,püt ,rek-örd }

output resistance [ELECTR] The resistance across the output terminals of a circuit or device. { 'aüt,püt ri,zis-töns }

output routine [COMPUT SCI] A series of computer instructions which organizes and directs all operations associated with the transcription of data from a computer to various media and external devices by various types of output equipment. Also known as output program. { 'aüt,püt rü,tēn }

output shaft [MECH ENG] The shaft that transfers motion from the prime mover to the driven machines. { 'aüt,püt ,shaft }

output stage [ELECTR] The final stage in any electronic equipment. { 'aüt,püt ,stāj }

output standard See standard time. { 'aüt,püt ,stan-dörd }

output transformer [ELECTR] The iron-core audio-frequency transformer used to match the output stage of a radio receiver or an amplifier to its loudspeaker or other load. { 'aüt ,püt tranz,för-mör }

output tube [ELECTR] Power-amplifier tube designed for use in an output stage. { 'aüt,püt ,tüb }

output unit [COMPUT SCI] In computers, a unit which delivers information from the computer to an external device or from internal storage to external storage. { 'aüt,püt ,yü-nät }

output winding [ELECTROMAG] Of a saturable reactor, a winding, other than a feedback winding, which is associated with the load, and through which power is delivered to the load. { 'aüt,püt ,wínd-ín }

output word [COMPUT SCI] Any running word into which an input word is to be translated. { 'aüt,püt ,wörd }

outrigger [ENG] A steel beam or lattice girder extending from a crane to provide stability by widening the base. { 'aüt,ríg-ör }

outside air temperature See indicated air temperature. { 'aüt,síd 'er ,tem-prä-chör }

outside calliper [DES ENG] A caliper having two curved legs which point toward each other; used for measuring outside dimensions of a workpiece. { 'aüt,síd 'kal-ä-pör }

outside diameter [DES ENG] The outer diameter of a pipe, including the wall thickness; usually measured with calipers. Abbreviated OD. { 'aüt,síd dī'am-äd-ör }

outside extension [COMMUN] Telephone extension on premises separated from the main station. { 'aüt,síd ik'sten-chön }

outside fix [NAV] The fix position determined by the method of bisectors when the lines of position result from observations of objects or celestial bodies lying within a 180° arc of the horizon. { 'aüt,síd 'fiks }

outside strake [NAV ARCH] The outer strake of an in-and-out system of shell plating; a strake which laps on the inner strake and which is the thickness of the plating outside the molded frame line. { 'aüt,síd 'strāk }

outside strake

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OUTSIDE CALIPER



Drawing of outside caliper.

which studies the biological and chemical components of medically useful substances that occur naturally (primarily those synthesized by plants). { fār-mā'käg-nā-sē }

pharmacokinetics [PHARM] The study of the way that drugs move through the body after they are swallowed or injected. { fār-mā-kō-ki'ned-iks }

pharmacolite [MINERAL] $\text{CaH}(\text{AsO}_4) \cdot 2\text{H}_2\text{O}$ A white to grayish monoclinic mineral composed of hydrous acid arsenate of calcium, occurring in fibrous form. { fār'mak-ə,lit }

pharmacologic pyrogen [PHARM] A naturally occurring pharmacologic agent, such as serotonin or a catecholamine, that controls body temperature; it can cause fever when injected under experimental conditions. { fār-mā-kə'lāj-ik 'pī-rə-jən }

pharmacology [CHEM] The science dealing with the nature and properties of drugs, particularly their actions. { fār-mā-kāl-ə-jē }

pharmacophobia [PSYCH] Abnormal fear of medicine. { fār-mā-kə'fō-bē-ə }

pharmacopoeia [PHARM] A book containing a selected list of medicinal substances and their dosage forms, providing also a description and the standards for purity and strength for each. { fār-mā-kə'pē-ə }

pharmacosiderite [MINERAL] $\text{Fe}_3(\text{AsO}_4)_2(\text{OH})_3 \cdot 5\text{H}_2\text{O}$ Green or yellowish-green mineral composed of a hydrous basic iron arsenate and commonly found in cubic crystals. Also known as cube ore. { fār-mā-kō'stīd-ə,rīt }

pharmacotherapy [MED] The treatment of disease by means of drugs. { fār-mā-kō'ther-ə-pē }

pharmacy Also known as pharmaceuticals. [MED] 1. The art and science of the preparation and dispensation of drugs. 2. A place where drugs are dispensed. { fār-mā-sē }

pharyngeal aponeurosis [ANAT] The fibrous submucous layer of the pharynx. { fə'rīn-jē-əl 'ap-ō-nū'rō-səs }

pharyngeal bursa [EMBRYO] A small pit caudal to the pharyngeal tonsil, resulting from the ingrowth of epithelium along the course of the degenerating tip of the notochord of the vertebrate embryo. { fə'rīn-jē-əl 'bər-sə }

pharyngeal cleft [EMBRYO] One of the paired open clefts on the sides of the embryonic pharynx between successive visceral arches in vertebrates. { fə'rīn-jē-əl 'kleft }

pharyngeal plexus [ANAT] A plexus of veins situated at the side of the pharynx. [NEUROSCI] A nerve plexus innervating the pharynx. { fə'rīn-jē-əl 'plek-səs }

pharyngeal pouch [EMBRYO] One of the five paired sacculations in the lateral aspect of the pharynx in vertebrate embryos. Also known as visceral pouch. { fə'rīn-jē-əl 'pauč }

pharyngeal tonsil See adenoid. { fə'rīn-jē-əl 'tān-səl }

pharyngeal tooth [VERT ZOO] A tooth developed on the pharyngeal bone in many fishes. { fə'rīn-jē-əl 'tūth }

pharyngitis [MED] Inflammation of the pharynx. { fār-ən'jīd-əs }

Pharyngobdellae [INV ZOO] A family of leeches in the order Arhynchobdellae that is distinguished by the lack of jaws. { fə'rīn,gäb'del-ə,dē }

pharyngology [MED] The science of the pharyngeal mechanism, functions, and diseases. { fār-īn'gäl-ə-jē }

pharyngoscope [MED] An instrument for examining the pharynx. { fə'rīn'gə-skōp }

pharyngo-tonsillar diphtheria [MED] A type of diphtheria that is characterized by a sore throat, difficulty in swallowing, and low-grade fever. { fə'rīn'gō,tāns-əl-ər dī'fthīr-ē-ə }

pharynx [ANAT] A chamber at the oral end of the vertebrate alimentary canal, leading to the esophagus. { fār-īnks }

phase [ASTRON] One of the cyclically repeating appearances of the moon or other orbiting body as seen from earth. [CHEM] Portion of a physical system (liquid, gas, solid) that is homogeneous throughout, has definable boundaries, and can be separated physically from other phases. [MATH] An additive constant in the argument of a trigonometric function. [MET] A constituent of an alloy that is physically distinct and is homogeneous in chemical composition. [PHYS] 1. The fractional part of a period through which the time variable of a periodic quantity (alternating electric current, vibration) has moved, as measured at any point in time from an arbitrary time origin; usually expressed in terms of angular measure, with one period being equal to 360° or 2π radians. 2. For a sinusoidally varying quantity, the phase (first definition) with the time origin located at the last point at which the quantity passed through

a zero position from a negative to a positive direction. 3. The argument of the trigonometric function describing the space and time variation of a sinusoidal disturbance, $y = A \cos \{(2\pi/\lambda)(x - vt)\}$, where x and t are the space and time coordinates, v is the velocity of propagation, and λ is the wavelength. [THERMO] The type of state of a system, such as solid, liquid, or gas. { fāz }

phase advancer [ELEC] Phase modifier which supplies leading reactive volt-amperes to the system to which it is connected; may be either synchronous or asynchronous. { fāz id,van-sər }

phase age See age of phase inequality. { fāz,āj }

phase-alternation line system [COMMUN] A color television system used in Europe, in which the phase of the color subcarrier is changed from scanning line to scanning line, requiring transmission of a line switching signal as well as a color burst. Abbreviated PAL system. { fāz,ōl-tər'nā-shən ,līn ,sis-təm }

phase angle [PHYS] The difference between the phase of a sinusoidally varying quantity and the phase of a second quantity which varies sinusoidally at the same frequency. Also known as phase difference. { fāz ,aŋ-gəl }

phase-angle meter See phase meter. { fāz ,aŋ-gəl ,mēd-ər }

phase-balance relay [ELEC] Relay which functions by reason of a difference between two quantities associated with different phases of a polyphase circuit. { fāz ,bal-əns 'rē,lā }

phase behavior [PETRO ENG] The equilibrium relationships between water, liquid hydrocarbons, and dissolved or free gas, either in reservoirs or as liquids and gases are separated above ground in gas-oil separator systems. { fāz bi,hāv-yər }

phase boundary [PHYS] The interface between two or more separate phases, such as liquid-gas, liquid-solid, gas-solid, or, for immiscible materials, liquid-liquid or solid-solid. { fāz ,baūn-drē }

phase change [PHYS] 1. The metamorphosis of a material or mixture from one phase to another, such as gas to liquid, solid to gas. 2. See phase shift. { fāz ,čhānj }

phase-change coefficient See phase constant. { fāz ,čhānj ,kō-i,fīsh-ənt }

phase-change material [ENG] A material which is used to store the latent heat absorbed in the material during a phase transition. { fāz ,čhānj mət,tīr-ē-əl }

phase-change recording [COMPUT SCI] An optical recording technique that uses a laser to alter the crystalline structure of a metallic surface to create bits that reflect or absorb light when they are illuminated during the read operation. { fāz ,čhānj rī'kōrd-īŋ }

phase coherence [PHYS] The existence of a statistical or time coherence between the phases of two or more waves. { fāz kō,hīr-əns }

phase comparator [COMPUT SCI] A comparator that accepts two radio-frequency input signals of the same frequency and provides two video outputs which are proportional, respectively, to the sine and cosine of the phase difference between the two inputs. { fāz kəm,par-əd-ər }

phase-comparison relaying [ELEC] A method of detecting faults in an electric power system in which signals are transmitted from each of two terminals every half cycle so that a continuous signal is received at an intermediate point if there is no fault between the terminals, while a periodic signal is received if there is a fault. { fāz kəm,par-ə-sən 'rē,lā-īŋ }

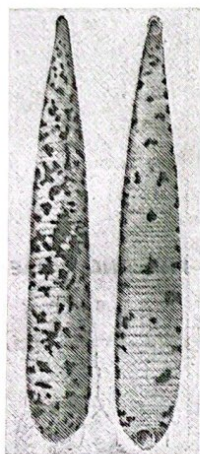
phase conductor [ELEC] In a polyphase circuit, any conductor other than the neutral conductor. { fāz kən,dəkt-ər }

phase conjugate system [OPTICS] An adaptive optics system in which the wavefront to be corrected is measured directly, using either a geometric or interferometric test. { fāz ,kän-jə-got ,sis-təm }

phase constant [ELECTROMAG] A rating for a line or medium through which a plane wave of a given frequency is being transmitted; it is the imaginary part of the propagation constant, and is the space rate of decrease of phase of a field component (or of the voltage or current) in the direction of propagation, in radians per unit length. Also known as phase-change coefficient; wavelength constant. { fāz ,kän-stənt }

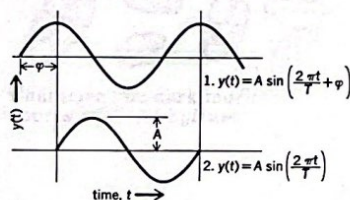
phase-contrast microscope [OPTICS] A compound microscope that has an annular diaphragm in the front focal plane of the substage condenser and a phase plate at the rear focal plane of the objective, to make visible differences in phase or

PHARYNGOBDELLAE



Dorsal and ventral view of *Erpobdella punctata*, a jawless leech common in lakes and streams in the Northern Hemisphere.

PHASE ANGLE



An illustration of the meaning of phase for a sinusoidal wave, $y(t)$. The difference in phase between waves 1 and 2 is ϕ and is called the phase angle. For each wave, A is the amplitude and T is the period.